HARRIS
COMMUNICATION AND
INFORMATION PROCESSING

UNITED RADIO TELEPHONE

Ser # H-0131

10-3-79

804-798-9128 PROD

804-257-0570 24 HR

Commonwealth Comm
P.O. Box 312
Ashland, VA 23005

# HA-4000

# MINIPAGE

~~RANDEL FULTON~~

GARY HOUSER 3893

DEN.

EXT ~~3889, 3890,~~ 3891, ~~3892, 3893~~

Commonwealth Comm. P.O. Box 312
Ashland VA 23005
Fred TERMINAL SERVICE INFORMATION
804-798-9128

HARRIS
RF COMMUNICATIONS

## AFTERHOURS AND WEEKEND EMERGENCIES 804-257-0570 24hr

During normal working hours, 7:30 A.M. to 5:00 P.M. Eastern time, RF Communications switchboard telephone number 716-244-5830 will connect you to Terminal Services for technical assistance. When calling the above number, please request to speak to the TERMINAL SERVICE GROUP at extensions 3889, 3890, 3891, 3892, or 3893.

In case of an emergency after normal working hours, an emergency telephone number has been established: 716-271-2132. After you call this number, the operator will contact an emergency team coordinator who will call you back to assist you (a thirty (30) minute delay before your call is returned is normal).

NOTES

Please do not call 716-244-5830 after 5 P.M.; this will only add delay before someone can assist you.
Collect calls will not be accepted at 716-271-2132.

When calling the emergency assistance number, please give the operator the following information.

1) caller's name
2) caller's company name
3) model number of terminal
4) telephone number (with area code) at which caller can be reached

NOTE: Please do not give the operator technical details of the problem you require assistance on.

## EXCHANGE PROGRAM

To minimize downtime, Harris Corporation Terminal Services has established a module exchange program. This program is an option open to all credit-approved users of Harris terminals. A stock of operational exchange modules is maintained and can be exchanged for a defective module under the following terms:

1) For a terminal which is under warranty, defective modules can be exchanged per warranty agreement plus special handling charges.
2) If the terminal is out of warranty, defective modules can be exchanged at a fixed cost plus special handling charges.

In either case, the defective modules are to be returned within thirty (30) days (North America) to keep the exchange pricing in effect. Failure to comply with the thirty (30) day return of a defective module will result in a billing at full list price of the operational module, less any applicable discount.

All exchange modules are warranted for the same period as a repaired assembly.
All warranties are based on the date of shipment from Harris to the user.

RANDELL FULTON

ITMF RECEIVER BOARD

10008-0100

GARY

7K8815138?

# HA-4000 MINIPAGE PROGRAMMING CARD

## AUDIBLE TWO-TONE

| DIGIT POSITION: | 1 2 3 | 4 | 5 | 6 7 | 8 9 |
|---|---|---|---|---|---|
| ENTER: | ADDRESS | 1 | * | TONE ONE | TONE TWO |

*0 = TONE ONLY
1 = TONE AND VOICE

## SUBAUDIBLE TWO-TONE

| DIGIT POSITION: | 1 2 3 | 4 | 5 | 6 7 | 8 9 |
|---|---|---|---|---|---|
| ENTER: | ADDRESS | 2 | * | TONE ONE | TONE TWO |

*0 = TONE ONLY
2 = TONE OVER VOICE

## FIVE-TONE

| DIGIT POSITION: | 1 2 3 | 4 | 5 6 7 8 9 |
|---|---|---|---|
| ENTER: | ADDRESS | 3 | FIVE TONES * |

(459 Hz IS AUTOMATICALLY SUBSTITUTED FOR THE SECOND CONSECUTIVE TONE OF THE SAME FREQUENCY.)

## SIX-TONE

| DIGIT POSITION: | 1 2 3 | 4 | 5 6 7 8 9 |
|---|---|---|---|
| ENTER: | ADDRESS | 4 | FIVE TONES * |

(SAME AS FIVE-TONE EXCEPT A SIXTH TONE=2010 Hz IS AUTOMATICALLY SENT.)

*

| ENTER | FREQ (Hz) |
|---|---|
| 0 | 600 |
| 1 | 741 |
| 2 | 882 |
| 3 | 1023 |
| 4 | 1164 |
| 5 | 1305 |
| 6 | 1446 |
| 7 | 1587 |
| 8 | 1728 |
| 9 | 1869 |

(FOR PREAMBLE, SET OPTION 00=1.)

## UNIVERSAL GROUP CALL

| DIGIT POSITION: | 1 2 3 | 4 | 5 6 | 7 8 9 |
|---|---|---|---|---|
| ENTER: | ADDRESS | 6 | * | START ADDRESS |

*NUMBER IN GROUP

## UNIVERSAL GROUP CALL WITH VOICE

| DIGIT POSITION: | 1 2 3 | 4 | 5 6 | 7 8 9 |
|---|---|---|---|---|
| ENTER: | ADDRESS | 7 | * | START ADDRESS |

(THE LAST PAGE IN THE GROUP MUST BE A TONE-AND-VOICE PAGE.)

*NUMBER IN GROUP

# HA-4000 MINIPAGE PROGRAMMING CARD

## AUDIBLE TWO-TONE

| DIGIT POSITION: | 1 2 3 | 4 | 5 | 6 7 | 8 9 |
|---|---|---|---|---|---|
| ENTER: | ADDRESS | 1 | * | TONE ONE | TONE TWO |

*0 = TONE ONLY
1 = TONE AND VOICE

## SUBAUDIBLE TWO-TONE

| DIGIT POSITION: | 1 2 3 | 4 | 5 | 6 7 | 8 9 |
|---|---|---|---|---|---|
| ENTER: | ADDRESS | 2 | * | TONE ONE | TONE TWO |

*0 = TONE ONLY
2 = TONE OVER VOICE

## FIVE-TONE

| DIGIT POSITION: | 1 2 3 | 4 | 5 6 7 8 9 |
|---|---|---|---|
| ENTER: | ADDRESS | 3 | FIVE TONES * |

(459 Hz IS AUTOMATICALLY SUBSTITUTED FOR THE SECOND CONSECUTIVE TONE OF THE SAME FREQUENCY.)

## SIX-TONE

| DIGIT POSITION: | 1 2 3 | 4 | 5 6 7 8 9 |
|---|---|---|---|
| ENTER: | ADDRESS | 4 | FIVE TONES * |

(SAME AS FIVE-TONE EXCEPT A SIXTH TONE=2010 Hz IS AUTOMATICALLY SENT.)

*

| ENTER | FREQ (Hz) |
|---|---|
| 0 | 600 |
| 1 | 741 |
| 2 | 882 |
| 3 | 1023 |
| 4 | 1164 |
| 5 | 1305 |
| 6 | 1446 |
| 7 | 1587 |
| 8 | 1728 |
| 9 | 1869 |

(FOR PREAMBLE, SET OPTION 00=1.)

## UNIVERSAL GROUP CALL

| DIGIT POSITION: | 1 2 3 | 4 | 5 6 | 7 8 9 |
|---|---|---|---|---|
| ENTER: | ADDRESS | 6 | * | START ADDRESS |

*NUMBER IN GROUP

## UNIVERSAL GROUP CALL WITH VOICE

| DIGIT POSITION: | 1 2 3 | 4 | 5 6 | 7 8 9 |
|---|---|---|---|---|
| ENTER: | ADDRESS | 7 | * | START ADDRESS |

(THE LAST PAGE IN THE GROUP MUST BE A TONE-AND-VOICE PAGE.)

*NUMBER IN GROUP

# HA-4000 MINIPAGE PROGRAMMING CARD

## AUDIBLE TWO-TONE

| DIGIT POSITION: | 1 2 3 | 4 | 5 | 6 7 | 8 9 |
|---|---|---|---|---|---|
| ENTER: | ADDRESS | 1 | * | TONE ONE | TONE TWO |

*0 = TONE ONLY
1 = TONE AND VOICE

## SUBAUDIBLE TWO-TONE

| DIGIT POSITION: | 1 2 3 | 4 | 5 | 6 7 | 8 9 |
|---|---|---|---|---|---|
| ENTER: | ADDRESS | 2 | * | TONE ONE | TONE TWO |

*0 = TONE ONLY
2 = TONE OVER VOICE

## FIVE-TONE

| DIGIT POSITION: | 1 2 3 | 4 | 5 6 7 8 9 |
|---|---|---|---|
| ENTER: | ADDRESS | 3 | FIVE TONES * |

(459 Hz IS AUTOMATICALLY SUBSTITUTED FOR THE SECOND CONSECUTIVE TONE OF THE SAME FREQUENCY.)

## SIX-TONE

| DIGIT POSITION: | 1 2 3 | 4 | 5 6 7 8 9 |
|---|---|---|---|
| ENTER: | ADDRESS | 4 | FIVE TONES * |

(SAME AS FIVE-TONE EXCEPT A SIXTH TONE=2010 Hz IS AUTOMATICALLY SENT.)

*

| ENTER | FREQ (Hz) |
|---|---|
| 0 | 600 |
| 1 | 741 |
| 2 | 882 |
| 3 | 1023 |
| 4 | 1164 |
| 5 | 1305 |
| 6 | 1446 |
| 7 | 1587 |
| 8 | 1728 |
| 9 | 1869 |

(FOR PREAMBLE, SET OPTION 00=1.)

## UNIVERSAL GROUP CALL

| DIGIT POSITION: | 1 2 3 | 4 | 5 6 | 7 8 9 |
|---|---|---|---|---|
| ENTER: | ADDRESS | 6 | * | START ADDRESS |

*NUMBER IN GROUP

## UNIVERSAL GROUP CALL WITH VOICE

| DIGIT POSITION: | 1 2 3 | 4 | 5 6 | 7 8 9 |
|---|---|---|---|---|
| ENTER: | ADDRESS | 7 | * | START ADDRESS |

(THE LAST PAGE IN THE GROUP MUST BE A TONE-AND-VOICE PAGE.)

*NUMBER IN GROUP

## AUDIBLE TWO-TONE FREQUENCIES

| DIGITS | FREQ (Hz) |
|---|---|
| 00 | 288.5 |
| 01 | 296.5 |
| 02 | 304.7 |
| 03 | 313.0 |
| 04 | 321.7 |
| 05 | 330.5 |
| 06 | 339.6 |
| 07 | 346.7 |
| 08 | 349.0 |
| 09 | 358.6 |
| 10 | 358.9 |
| 11 | 368.5 |
| 12 | 371.5 |
| 13 | 378.6 |
| 14 | 384.6 |
| 15 | 389.0 |
| 16 | 398.1 |
| 17 | 399.8 |
| 18 | 410.8 |
| 19 | 412.1 |
| 20 | 422.1 |
| 21 | 426.6 |
| 22 | 433.7 |
| 23 | 441.6 |
| 24 | 445.7 |
| 25 | 457.1 |
| 26 | 457.9 |
| 27 | 470.5 |
| 28 | 473.2 |
| 29 | 483.5 |
| 30 | 489.8 |
| 31 | 496.8 |
| 32 | 507.0 |
| 33 | 510.5 |
| 34 | 524.6 |
| 35 | 524.8 |
| 36 | 539.0 |
| 37 | 543.3 |
| 38 | 553.9 |
| 39 | 562.3 |
| 40 | 569.1 |
| 41 | 582.1 |
| 42 | 584.8 |
| 43 | 600.9 |
| 44 | 602.6 |
| 45 | 617.4 |
| 46 | 623.7 |
| 47 | 634.5 |
| 48 | 645.7 |
| 49 | 651.9 |

| DIGITS | FREQ (Hz) |
|---|---|
| 50 | 668.3 |
| 51 | 669.9 |
| 52 | 688.3 |
| 53 | 691.8 |
| 54 | 707.3 |
| 55 | 716.1 |
| 56 | 726.8 |
| 57 | 741.3 |
| 58 | 746.8 |
| 59 | 767.4 |
| 60 | 788.5 |
| 61 | 794.3 |
| 62 | 810.2 |
| 63 | 822.2 |
| 64 | 832.5 |
| 65 | 851.1 |
| 66 | 855.5 |
| 67 | 879.0 |
| 68 | 881.0 |
| 69 | 903.2 |
| 70 | 912.0 |
| 71 | 928.1 |
| 72 | 944.1 |
| 73 | 953.7 |
| 74 | 979.9 |
| 75 | 1006.9 |
| 76 | 1034.7 |
| 77 | 1063.2 |
| 78 | 1092.4 |
| 79 | 1122.5 |
| 80 | 1153.4 |
| 81 | 1185.2 |
| 82 | 1217.8 |
| 83 | 1251.4 |
| 84 | 1285.8 |
| 85 | 1321.2 |
| 86 | 1357.6 |
| 87 | 1395.0 |
| 88 | 1433.4 |
| 89 | 977.2 |
| 90 | 1011.6 |
| 91 | 1047.1 |
| 92 | 1084.0 |
| 93 | 1122.1 |
| 94 | 1161.4 |
| 95 | N/D |
| 96 | N/D |
| 97 | N/D |
| 98 | N/D |
| 99 | N/D |

## SUBAUDIBLE TWO-TONE FREQUENCIES

| DIGITS | FREQ (Hz) |
|---|---|
| 00 | 67.0 |
| 01 | 71.9 |
| 02 | 77.0 |
| 03 | 82.5 |
| 04 | N/D |
| 05 | N/D |
| 06 | N/D |
| 07 | N/D |
| 08 | N/D |
| 09 | N/D |
| 10 | 85.4 |
| 11 | 88.5 |
| 12 | 91.5 |
| 13 | 94.8 |
| 14 | 79.4 |
| 15 | 100.0 |
| 16 | 103.5 |
| 17 | 107.2 |
| 18 | 110.9 |
| 19 | 114.8 |
| 20 | 118.8 |
| 21 | 123.0 |
| 22 | 127.3 |
| 23 | 131.8 |
| 24 | 136.5 |
| 25 | 141.3 |
| 26 | 146.2 |
| 27 | 151.4 |
| 28 | 156.7 |
| 29 | 162.2 |
| 30 | 167.9 |
| 31 | 173.8 |
| 32 | 179.9 |
| 33 | 186.2 |
| 34 | 192.8 |
| 35 | 202.7 |
| 36 | N/D |
| 37 | N/D |
| 38 | N/D |
| 39 | N/D |

N/D=NOT DEFINED

## AUDIBLE TWO-TONE FREQUENCIES

| DIGITS | FREQ (Hz) |
|---|---|
| 00 | 288.5 |
| 01 | 296.5 |
| 02 | 304.7 |
| 03 | 313.0 |
| 04 | 321.7 |
| 05 | 330.5 |
| 06 | 339.6 |
| 07 | 346.7 |
| 08 | 349.0 |
| 09 | 358.6 |
| 10 | 358.9 |
| 11 | 368.5 |
| 12 | 371.5 |
| 13 | 378.6 |
| 14 | 384.6 |
| 15 | 389.0 |
| 16 | 398.1 |
| 17 | 399.8 |
| 18 | 410.8 |
| 19 | 412.1 |
| 20 | 422.1 |
| 21 | 426.6 |
| 22 | 433.7 |
| 23 | 441.6 |
| 24 | 445.7 |
| 25 | 457.1 |
| 26 | 457.9 |
| 27 | 470.5 |
| 28 | 473.2 |
| 29 | 483.5 |
| 30 | 489.8 |
| 31 | 496.8 |
| 32 | 507.0 |
| 33 | 510.5 |
| 34 | 524.6 |
| 35 | 524.8 |
| 36 | 539.0 |
| 37 | 543.3 |
| 38 | 553.9 |
| 39 | 562.3 |
| 40 | 569.1 |
| 41 | 582.1 |
| 42 | 584.8 |
| 43 | 600.9 |
| 44 | 602.6 |
| 45 | 617.4 |
| 46 | 623.7 |
| 47 | 634.5 |
| 48 | 645.7 |
| 49 | 651.9 |

| DIGITS | FREQ (Hz) |
|---|---|
| 50 | 668.3 |
| 51 | 669.9 |
| 52 | 688.3 |
| 53 | 691.8 |
| 54 | 707.3 |
| 55 | 716.1 |
| 56 | 726.8 |
| 57 | 741.3 |
| 58 | 746.8 |
| 59 | 767.4 |
| 60 | 788.5 |
| 61 | 794.3 |
| 62 | 810.2 |
| 63 | 822.2 |
| 64 | 832.5 |
| 65 | 851.1 |
| 66 | 855.5 |
| 67 | 879.0 |
| 68 | 881.0 |
| 69 | 903.2 |
| 70 | 912.0 |
| 71 | 928.1 |
| 72 | 944.1 |
| 73 | 953.7 |
| 74 | 979.9 |
| 75 | 1006.9 |
| 76 | 1034.7 |
| 77 | 1063.2 |
| 78 | 1092.4 |
| 79 | 1122.5 |
| 80 | 1153.4 |
| 81 | 1185.2 |
| 82 | 1217.8 |
| 83 | 1251.4 |
| 84 | 1285.8 |
| 85 | 1321.2 |
| 86 | 1357.6 |
| 87 | 1395.0 |
| 88 | 1433.4 |
| 89 | 977.2 |
| 90 | 1011.6 |
| 91 | 1047.1 |
| 92 | 1084.0 |
| 93 | 1122.1 |
| 94 | 1161.4 |
| 95 | N/D |
| 96 | N/D |
| 97 | N/D |
| 98 | N/D |
| 99 | N/D |

## SUBAUDIBLE TWO-TONE FREQUENCIES

| DIGITS | FREQ (Hz) |
|---|---|
| 00 | 67.0 |
| 01 | 71.9 |
| 02 | 77.0 |
| 03 | 82.5 |
| 04 | N/D |
| 05 | N/D |
| 06 | N/D |
| 07 | N/D |
| 08 | N/D |
| 09 | N/D |
| 10 | 85.4 |
| 11 | 88.5 |
| 12 | 91.5 |
| 13 | 94.8 |
| 14 | 79.4 |
| 15 | 100.0 |
| 16 | 103.5 |
| 17 | 107.2 |
| 18 | 110.9 |
| 19 | 114.8 |
| 20 | 118.8 |
| 21 | 123.0 |
| 22 | 127.3 |
| 23 | 131.8 |
| 24 | 136.5 |
| 25 | 141.3 |
| 26 | 146.2 |
| 27 | 151.4 |
| 28 | 156.7 |
| 29 | 162.2 |
| 30 | 167.9 |
| 31 | 173.8 |
| 32 | 179.9 |
| 33 | 186.2 |
| 34 | 192.8 |
| 35 | 202.7 |
| 36 | N/D |
| 37 | N/D |
| 38 | N/D |
| 39 | N/D |

**N/D=NOT DEFINED**

## AUDIBLE TWO-TONE FREQUENCIES

| DIGITS | FREQ (Hz) |
|---|---|
| 00 | 288.5 |
| 01 | 296.5 |
| 02 | 304.7 |
| 03 | 313.0 |
| 04 | 321.7 |
| 05 | 330.5 |
| 06 | 339.6 |
| 07 | 346.7 |
| 08 | 349.0 |
| 09 | 358.6 |
| 10 | 358.9 |
| 11 | 368.5 |
| 12 | 371.5 |
| 13 | 378.6 |
| 14 | 384.6 |
| 15 | 389.0 |
| 16 | 398.1 |
| 17 | 399.8 |
| 18 | 410.8 |
| 19 | 412.1 |
| 20 | 422.1 |
| 21 | 426.6 |
| 22 | 433.7 |
| 23 | 441.6 |
| 24 | 445.7 |
| 25 | 457.1 |
| 26 | 457.9 |
| 27 | 470.5 |
| 28 | 473.2 |
| 29 | 483.5 |
| 30 | 489.8 |
| 31 | 496.8 |
| 32 | 507.0 |
| 33 | 510.5 |
| 34 | 524.6 |
| 35 | 524.8 |
| 36 | 539.0 |
| 37 | 543.3 |
| 38 | 553.9 |
| 39 | 562.3 |
| 40 | 569.1 |
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| 43 | 600.9 |
| 44 | 602.6 |
| 45 | 617.4 |
| 46 | 623.7 |
| 47 | 634.5 |
| 48 | 645.7 |
| 49 | 651.9 |

| DIGITS | FREQ (Hz) |
|---|---|
| 50 | 668.3 |
| 51 | 669.9 |
| 52 | 688.3 |
| 53 | 691.8 |
| 54 | 707.3 |
| 55 | 716.1 |
| 56 | 726.8 |
| 57 | 741.3 |
| 58 | 746.8 |
| 59 | 767.4 |
| 60 | 788.5 |
| 61 | 794.3 |
| 62 | 810.2 |
| 63 | 822.2 |
| 64 | 832.5 |
| 65 | 851.1 |
| 66 | 855.5 |
| 67 | 879.0 |
| 68 | 881.0 |
| 69 | 903.2 |
| 70 | 912.0 |
| 71 | 928.1 |
| 72 | 944.1 |
| 73 | 953.7 |
| 74 | 979.9 |
| 75 | 1006.9 |
| 76 | 1034.7 |
| 77 | 1063.2 |
| 78 | 1092.4 |
| 79 | 1122.5 |
| 80 | 1153.4 |
| 81 | 1185.2 |
| 82 | 1217.8 |
| 83 | 1251.4 |
| 84 | 1285.8 |
| 85 | 1321.2 |
| 86 | 1357.6 |
| 87 | 1395.0 |
| 88 | 1433.4 |
| 89 | 977.2 |
| 90 | 1011.6 |
| 91 | 1047.1 |
| 92 | 1084.0 |
| 93 | 1122.1 |
| 94 | 1161.4 |
| 95 | N/D |
| 96 | N/D |
| 97 | N/D |
| 98 | N/D |
| 99 | N/D |

## SUBAUDIBLE TWO-TONE FREQUENCIES

| DIGITS | FREQ (Hz) |
|---|---|
| 00 | 67.0 |
| 01 | 71.9 |
| 02 | 77.0 |
| 03 | 82.5 |
| 04 | N/D |
| 05 | N/D |
| 06 | N/D |
| 07 | N/D |
| 08 | N/D |
| 09 | N/D |
| 10 | 85.4 |
| 11 | 88.5 |
| 12 | 91.5 |
| 13 | 94.8 |
| 14 | 79.4 |
| 15 | 100.0 |
| 16 | 103.5 |
| 17 | 107.2 |
| 18 | 110.9 |
| 19 | 114.8 |
| 20 | 118.8 |
| 21 | 123.0 |
| 22 | 127.3 |
| 23 | 131.8 |
| 24 | 136.5 |
| 25 | 141.3 |
| 26 | 146.2 |
| 27 | 151.4 |
| 28 | 156.7 |
| 29 | 162.2 |
| 30 | 167.9 |
| 31 | 173.8 |
| 32 | 179.9 |
| 33 | 186.2 |
| 34 | 192.8 |
| 35 | 202.7 |
| 36 | N/D |
| 37 | N/D |
| 38 | N/D |
| 39 | N/D |

N/D=NOT DEFINED

Incorporate the following information in instruction manual PM-1440A for the HA-4000 Minipage terminal.

Add step 10 as follows on page 2-12.

10. With Electronic Switching Service (ESS) offices, it may be necessary to de-sensitize the opto-coupler (IC-F4) on the trunk interface board(s). P/N 10008-1700. To do this, select a value of resistance for R40 (refer to figure 24, sheet 1 of 4, in PM-1666) from the graph below. The resistor value may also be determined by measuring the voltage across R17 and dividing this reading by 100. A typical value for R40 is 60K. However, since each installation is different, the actual value of R40 may be higher or lower than the typical value.

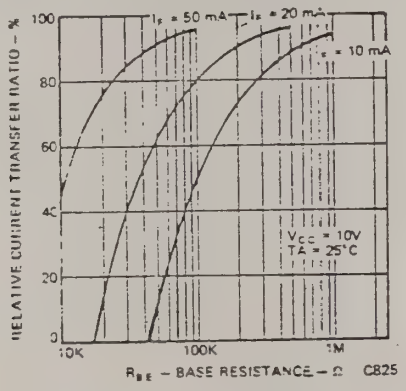


*Fig. 17 Sensitivity vs. Base Resistance*

$I_F$ = Current through R17

$I_O$ = Maximum current into C4

# ADDENDUM TO HA-4000 MINIPAGE MANUAL

RE: Use of J1 Shunt Jumper on Subscriber Memory Card

Upon leaving the factory, the shunt jumper, J1, on the Subscriber Memory Card is placed on only one (1) pin of P3 to retain battery charge during storage.

Before the Minipage terminal can be programmed, jumper J1 must be placed on both (2) pins of P3 to allow the batteries to charge and provide memory retention during power down situations.

## I. PURPOSE

This instruction sheet is intended as a guide to select an operating location for your new Harris HA-4000 Minipage terminal and provide pre-installation information. The information contained herein should be applied to any computer or microprocessor installation in order to provide maximum life, performance and reliability.

## II. EQUIPMENT ROOM DESIGN

A. Your new HA-4000 Minipage Terminal is a modern, solid-state system employing the very latest in integrated circuit and microprocessor technology designed to provide years of trouble-free service. Like any sophisticated piece of equipment, the system will provide maximum life, performance and reliability only if properly installed and maintained. Furthermore, full consideration should be given to ease of equipment accessibility for maintenance and re-programming purposes.

B. Environment - The computer equipment should be installed in a clean, dry room (less than 90% relative humidity, non-condensing) with heating and air-conditioning facilities capable of maintaining a room temperature within the range of the temperature specification for the equipment. (For the Minipage Terminal, this is from 32°F to 122°F (10°C to 32°C)). The equipment room should be well-illuminated for ease of programming and maintenance.

The system should not be installed in areas where extremely severe electrical noise conditions occur, as in broadcast transmitter sites, power company substations or elevator equipment rooms.

The HA-4000 Minipage Terminal should be installed in a computer-type environment. When the HA-4000 Minipage Terminal is installed, effort should be made to ensure that the area around the terminal meets the following requirements:

1. Flooring requirements - The floor in the area of the terminal should be linoleum or concrete: however, carpeted areas may be used. When the terminal is installed in a carpeted environment, the carpets should be conductive or treated with an anti-static compound. Anti-static compounds are available from most carpet cleaning companies or commercial anti-static sprays (such as "Static Guard" produced by Alberto-Culver Co.) which are available in most supermarkets. Treatment may be required in severe static environments weekly. Traffic in the immediate area of the Minipage should be restricted.

2. Power and Grounding - A minimum of one duplex outlet providing 105-125 Vac (210-250 Vac) 47-63 Hz, single-phase current should be provided in the equipment room, close to the proposed location of the terminal. All outlets must be of a 3-wire grounding type and capable of supplying a minimum of 100 watts.

NOTE

Under no circumstances should a stamping time clock, copying machine, motor of any sort, thermostatically controlled heater or similar equipment be placed on the same service with any computer equipment. All produce heavy line transients which may interfere with proper operation of the system.

Ground leads should be located near the proposed location of the terminal. These ground leads must be terminated in a good, earth ground such as a water pipe or metallic sub-structure. When the terminal is installed, the ground lead should be connected to a screw located in either lower corner of the terminal cabinet rear panel. The ground lead should be #14 AWG copper wire, 1/4 inch tinned copper braid or large conductor, and should not exceed a length of 10 feet.

The desk or bench on which the terminal is operated should also be grounded. Grounding can be achieved by using a similar ground lead as previously described.

## III. PRE-ARRIVAL PREPARATIONS

Proper preparation of the equipment location prior to arrival of the equipment will assure a quick, easy installation. If all points noted on the following checklist are observed, installation should be quick and trouble-free.

NOTE

If new telephone lines must be installed, notify the Telephone Company well in advance of the arrival date of your equipment, or installation delays may result. Trunk lines may require equipment with lead times as great as 12 months.

| | PRE-INSTALLATION CHECKLIST | CHECK |
|---|---|---|
| 1 | Telephone trunk lines are in place and functioning properly. | |
| 2 | Transmitter lines are in place. | |
| 3 | Telephone lines and transmitter lines have lightening protectors installed (lightening protectors are optional but recommended). | |
| 4 | Floors are concrete, linoleum or anti-static carpet. | |
| 5 | Ground leads are in place. | |
| 6 | Power service lines have been installed. | |
| 7 | Location for console and tape decks is provided (if required). | |
| 8 | Trunks should be tagged with circuit number. | |
| 9 | An outside telephone line should be available in easy viewing range of the terminal location. This will be used for dialing through the telephone office to check proper operation of the terminal at the time of installation. | |
| 10 | A standard dial (or "Touch Tone$^{R}$" if end-to-end signaling is used) or a linemans handset should be available for test purposes. | |
| 11 | A transmitter keying source (power supply) must be provided. (The terminal provides a dry contact closure to indicate transmitter keying). | |

Incorporate the following information in instruction manual PM-1440A for the HA-4000 Minipage terminal.

Add step 10 as follows on page 2-12.

10. With Electronic Switching Service (ESS) offices, it may be necessary to de-sensitize the opto-coupler (IC-F4) on the trunk interface board(s). P/N 10008-1700. To do this, select a value of resistance for R40 (refer to figure 24, sheet 1 of 4, in PM-1666) from the graph below. The resistor value may also be determined by measuring the voltage across R17 and dividing this reading by 100. A typical value for R40 is 60K. However, since each installation is different, the actual value of R40 may be higher or lower than the typical value.

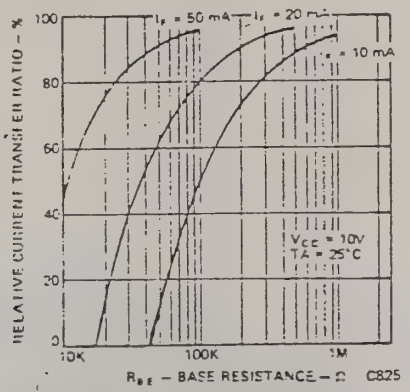


*Fig. 17 Sensitivity vs. Base Resistance*

$I_F$ = Current through R17

$I_O$ = Maximum current into C4

HARRIS COMMUNICATION AND INFORMATION PROCESSING

PM 1440A

# HA-4000

# MINIPAGE MANUAL



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# SECTION I
# GENERAL INFORMATION

## A. GENERAL DESCRIPTION

The HA-4000 Minipage Terminal is a 600 subscriber number automatic paging terminal capable of interfacing up to three telephone trunks and one transmitter. The terminal may be operated with as few as 100 numbers and expanded in 100 number increments to a total of 600 numbers. Number assignment is random and 100 percent number invalidation and transfer is standard. Optional signaling encoders are not required; standard tone signaling includes the following: Motorola two-tone audible, Motorola 5/6-tone, and Motorola two-tone subaudible. The terminal is arranged for tabletop operation on 120 Vac or 240 Vac, 50/60 Hz. (Figure 1-1).

## B. BASIC TERMINAL

The basic HA-4000 Minipage Terminal includes a 100 number solid-state memory with on-card back up battery power, a separate programming console for programming the memory, operator input and status display, one selector level trunk interface, one transmitter interface with CW identification, external busy, signal encoding for two-tone, 5/6-tone and subaudible, group call and a 64 call tone-only memory. The basic terminal is also wired for two additional trunk interfaces, 500 more numbers and two message recorders, as well as other miscellaneous options.

## C. OPTIONS

### Trunk Interface Options

Up to two additional trunk interfaces may be added. The selector level trunk interfaces may be converted to end-to-end interfaces

by adding the optional DTMF receiver board and reprogramming the trunk card. Only one DTMF receiver board is required for all three trunk interfaces.

## Memory

Additional memory modules can be installed in 100 number increments and although up to five memory modules can be added, they must be added in sequence.

## Call Counter

The call counter option has the capability to count up to 999 subscriber calls and will display the total count on the programming console.

## Tape Deck

Up to two HA-4011 Tape Decks may be interfaced to the Minipage. Only one of these tape decks can be used for transmitter voice identification while both can be used for instructional, advertising or wrong number messages.

## Miscellaneous

The programming console can be provided with a one-way voice interface. Any one of the three trunk interfaces or the console may be designated a priority interrupt. As such, all calls on that input interface will receive priority over all other pending calls.

# HA-4000 MINIPAGE PROGRAMMING CARD

## AUDIBLE TWO-TONE

| DIGIT POSITION: | 1 2 3 | 4 | 5 | 6 7 | 8 9 |
|---|---|---|---|---|---|
| ENTER: | ADDRESS | 1 | * | TONE ONE | TONE TWO |

*0 = TONE ONLY
1 = TONE AND VOICE

## SUBAUDIBLE TWO-TONE

| DIGIT POSITION: | 1 2 3 | 4 | 5 | 6 7 | 8 9 |
|---|---|---|---|---|---|
| ENTER: | ADDRESS | 2 | * | TONE ONE | TONE TWO |

*0 = TONE ONLY
2 = TONE OVER VOICE

## FIVE-TONE

| DIGIT POSITION: | 1 2 3 | 4 | 5 6 7 8 9 |
|---|---|---|---|
| ENTER: | ADDRESS | 3 | FIVE TONES * |

(459 Hz IS AUTOMATICALLY SUBSTITUTED FOR THE SECOND CONSECUTIVE TONE OF THE SAME FREQUENCY.)

## SIX-TONE

| DIGIT POSITION: | 1 2 3 | 4 | 5 6 7 8 9 |
|---|---|---|---|
| ENTER: | ADDRESS | 4 | FIVE TONES * |

(SAME AS FIVE-TONE EXCEPT A SIXTH TONE=2010 Hz IS AUTOMATICALLY SENT.)

*

| ENTER | FREQ (Hz) |
|---|---|
| 0 | 600 |
| 1 | 741 |
| 2 | 882 |
| 3 | 1023 |
| 4 | 1164 |
| 5 | 1305 |
| 6 | 1446 |
| 7 | 1587 |
| 8 | 1728 |
| 9 | 1869 |

(FOR PREAMBLE, SET OPTION 00=1.)

## UNIVERSAL GROUP CALL

| DIGIT POSITION: | 1 2 3 | 4 | 5 6 | 7 8 9 |
|---|---|---|---|---|
| ENTER: | ADDRESS | 6 | * | START ADDRESS |

*NUMBER IN GROUP

## UNIVERSAL GROUP CALL WITH VOICE

| DIGIT POSITION: | 1 2 3 | 4 | 5 6 | 7 8 9 |
|---|---|---|---|---|
| ENTER: | ADDRESS | 7 | * | START ADDRESS |

(THE LAST PAGE IN THE GROUP MUST BE A TONE-AND-VOICE PAGE.)

*NUMBER IN GROUP

AUDIBLE TWO-TONE FREQUENCIES

| DIGITS | FREQ. (Hz) | DIGITS | FREQ. (Hz) |
|---|---|---|---|
| 00 | 288.5 | 83 | 1251.4 |
| 01 | 296.5 | 84 | 1285.8 |
| 02 | 304.7 | 85 | 1321.2 |
| 03 | 313.0 | 86 | 1357.6 |
| 04 | 321.7 | 87 | 1395.0 |
| 05 | 330.5 | 88 | 1433.4 |
| 06 | 339.6 | 95 | N/D |
| 08 | 349.0 | 96 | N/D |
| 09 | 358.6 | 97 | N/D |
| 11 | 368.5 | 98 | N/D |
| 13 | 378.6 | 99 | N/D |
| 15 | 389.0 | | |
| 17 | 399.8 | N/D = Not Defined | |
| 18 | 410.8 | | |
| 20 | 422.1 | | |
| 22 | 433.7 | | |
| 24 | 445.7 | | |
| 26 | 457.9 | | |
| 27 | 470.5 | | |
| 29 | 483.5 | | |
| 31 | 496.8 | | |
| 33 | 510.5 | | |
| 34 | 524.6 | | |
| 36 | 539.0 | | |
| 38 | 553.9 | | |
| 40 | 569.1 | | |
| 42 | 584.8 | | |
| 43 | 600.9 | | |
| 45 | 617.4 | | |
| 47 | 634.5 | | |
| 49 | 651.9 | | |
| 51 | 669.9 | | |
| 52 | 688.3 | | |
| 54 | 707.3 | | |
| 56 | 726.8 | | |
| 58 | 746.8 | | |
| 59 | 767.4 | | |
| 60 | 788.5 | | |
| 62 | 810.2 | | |
| 64 | 832.5 | | |
| 66 | 855.5 | | |
| 67 | 879.0 | | |
| 69 | 903.2 | | |
| 71 | 928.1 | | |
| 73 | 953.7 | | |
| 74 | 979.9 | | |
| 75 | 1006.9 | | |
| 76 | 1034.7 | | |
| 77 | 1063.2 | | |
| 78 | 1092.4 | | |
| 79 | 1122.5 | | |
| 80 | 1153.4 | | |
| 81 | 1185.2 | | |
| 82 | 1217.8 | | |

SUBAUDIBLE TWO-TONE FREQUENCIES

| DIGITS | FREQ. (Hz) |
|---|---|
| 00 | 67.0 |
| 01 | 71.9 |
| 02 | 77.0 |
| 03 | 82.5 |
| 04 | 69.3 |
| 05 | 74.4 |
| 06 | N/D |
| 07 | N/D |
| 08 | N/D |
| 09 | N/D |
| 10 | 85.4 |
| 11 | 88.5 |
| 12 | 91.5 |
| 13 | 94.8 |
| 14 | 79.7 |
| 15 | 100.0 |
| 16 | 103.5 |
| 17 | 107.2 |
| 18 | 110.9 |
| 19 | 114.8 |
| 20 | 118.8 |
| 21 | 123.0 |
| 22 | 127.3 |
| 23 | 131.8 |
| 24 | 136.5 |
| 25 | 141.3 |
| 26 | 146.2 |
| 27 | 151.4 |
| 28 | 156.7 |
| 29 | 162.2 |
| 30 | 167.9 |
| 31 | 173.8 |
| 32 | 179.9 |
| 33 | 186.2 |
| 34 | 192.8 |
| 35 | 202.7 |
| 36 | N/D |
| 37 | N/D |
| 38 | N/D |
| 39 | N/D |

N/D = Not Defined

GE 99 TWO-TONE FREQUENCIES

| DIGITS | FREQ. (Hz) |
|---|---|
| 07 | 682.5 |
| 10 | 592.5 |
| 12 | 757.5 |
| 14 | 802.5 |
| 16 | 847.5 |
| 19 | 892.5 |
| 21 | 937.5 |
| 23 | 547.5 |
| 25 | 727.5 |
| 28 | 637.5 |
| 30 | 652.5 |
| 32 | 607.5 |
| 35 | 787.5 |
| 37 | 832.5 |
| 39 | 877.5 |
| 41 | 922.5 |
| 44 | 967.5 |
| 46 | 517.5 |
| 48 | 562.5 |
| 50 | 697.5 |
| 53 | 667.5 |
| 55 | 712.5 |
| 57 | 772.5 |
| 61 | 817.5 |
| 63 | 862.5 |
| 65 | 907.5 |
| 68 | 952.5 |
| 70 | 532.5 |
| 72 | 577.5 |
| 89 | 622.5 |
| 90 | 742.5 |
| 91 | N/D |
| 92 | N/D |
| 93 | N/D |
| 94 | N/D |

N/D = Not Defined

E. PROGRAMMABLE FEATURES/FUNCTION REFERENCE CHART FOR HA-4000 MINIPAGE PROGRAMMING

| Programmable Feature Number | Function | Enter | Factory Set To | Customer Installation Set To |
|---|---|---|---|---|
| 00 | Preamble Required | 0 = No<br>1 = Yes | 0 | |
| 01 | 5/6 Tone as Tone-Over-Voice | 0 = No<br>1 = Yes | 0 | |
| 02 | Console Voice | 1 = Yes | | |
| 03 | Transmitter Alarm Enable | 0 = No<br>1 = Yes | 0 | |
| 04 | Trunk 1 Phantom Digit Required | 0 = No<br>1 = Yes | 0 | |
| 05 | Trunk 2 Phantom Digit Required | 0 = No<br>1 = Yes | 0 | |
| 06 | Trunk 3 Phantom Digit Required | 0 = No<br>1 = Yes | 0 | |
| 07 | Morse ID Required | 0 = No<br>1 = Yes | 1 | |
| 10 | Parity Checking Required | 0 = No<br>1 = Yes | 0 | |
| 30 | Camp On Ringing Time | 01-10 | 03 | |
| 31 | Voice Interval Time | 01-10 | 03 | |
| 32 | Duration of First Tone | 01-10 | 02 | |
| 33 | Duration of Intertone Gap | 01-10 | 10 | |
| 34 | Duration of Second Tone | 01-10 | 06 | |
| 35 | Duration of Tone to Voice Interval | 01-10 | 03 | |
| 36 | Duration of First Subaudible Tone | 01-10 | 02 | |
| 37 | Duration of Intertone Subaudible Gap | 01-10 | 10 | |
| 38 | Duration of Second Subaudible Gap | 01-10 | 06 | |
| 39 | Number of Page Repeats | 01-10 | 01 | |

E.(Continued)

| Programmable Feature Number | Function | Enter | Factory Set To | Customer Installation Set To |
|---|---|---|---|---|
| 40 | Transmitter Carrier Delay Time | 01-10 | 05 | |
| 41 | Transmitter Alarm Time | 01-10 | 01 | |
| 42 | Interdigit Abandonment Time | 01-10 | 01 | |
| 43 | ID Timer | 01-10 | 04 | |
| 44 | Speed of Morse ID | 01-10 | 01 | |
| 45 | Number of ID Transmissions | 01-10 | 01 | |
| 60 | Ad Message Required | 00-02 | 00 | |
| 61 | Wrong Number Message Required | 00-02 | 00 | |
| 62 | Voice ID Required | 00-02 | 00 | |
| 70 | Priority Trunk | 00-05 | 04 | |
| 71 | Trunk 1 Phantom Digit | 00-05 | 00 | |
| 72 | Trunk 2 Phantom Digit | 00-05 | 00 | |
| 73 | Trunk 3 Phantom Digit | 00-05 | 00 | |
| 80 | Minimum Connect Time (6 sec min) | 00-10 | 00 | |
| 84 | Trunk 1 Offset | 00-09 | 00 | |
| 85 | Trunk 2 Offset | 00-09 | 00 | |
| 86 | Trunk 3 Offset | 00-09 | 00 | |

## F. SPECIFICATIONS

### Physical

| | |
|---|---|
| Number of Subscribers | 100 to 600 |
| Interfaces with Telephone Company Central Office | Up to 3 trunks or lines |
| Types of Input | Selector Level or End-to-End |
| Nominal Input Impedance | 900 ohms (balanced) |
| Input Level | -30 to 0 dBm |
| Transmitter Control | Dry closure (3PST), 1A/50V each |
| Modes of Operation | Tone-Only, Tone-and-Voice, Tone-Over-Voice |
| Tone Generation (all standard) | Two-Tone, 5-Tone, Preamble 6-Tone, Subaudible |
| Tone Stability | 0.05% |
| Tone Accuracy | 0.1% of any desired tone |
| Nominal Output Impedance | 900 ohms |
| Tone Output Level | -15 dBm to +5 dBm adjustable into 900 ohms |
| Audio Distortion | Less than 5% at 0 dBm into 900 ohms |
| Tone-Only Memory (standard) | 64-call storage |
| Number of Page Repeats | 1-10 adjustable on two-tone, 1 on 5/6-tone |
| Automatic Transmitter ID | Electronic Morse code (standard); voice ID (optional) |
| Supervisory Tones Level | -35 to 0 dBm into 900 ohms |
| Status and Diagnostic Display | Complete LED display |
| Number Invalidation and Transfer | 100% (standard) |
| Operating Environment | $32^{\circ}F$ ($0^{\circ}C$) to $122^{\circ}F$ ($50^{\circ}C$) 90% humidity, non-condensing |

| | |
|---|---|
| Console Microphone Level | (For use with console voice option)<br>35 ±15 mV RMS/microbar @ 1 kHz across 242 dBm |
| Power Requirements | 105-125 Vac, 210-250 Vac, 47-63 Hz; power approximately 100 watts |
| Cabinet Dimensions | 17W x 18.5D x 9H in.<br>(43W x 47D x 23H cm) |
| Weight | 75 lb. (34 kilograms) |
| Console Dimensions | 8.5W x 7D x 4H in.<br>(22W x 18D x 10H cm) |
| Weight | 4 lb. (1.8 kilograms) |

Alarm Circuit Interface

Output: One single pole, single throw normally open contact.
Maximum contact current - 1 amp.
Maximum contact voltage - 50V.

Alarm Contacts close if:

1. If processor fails.
2. If any internal dc voltages drop below a minimum level.
3. Self test fails.
4. Transmitter is busy for longer than two (2) minutes if feature 03 is set for 01, factory preset to OFF position (00), will display "CUE-2".

To reset the alarm, the unit must be momentarily turned off.

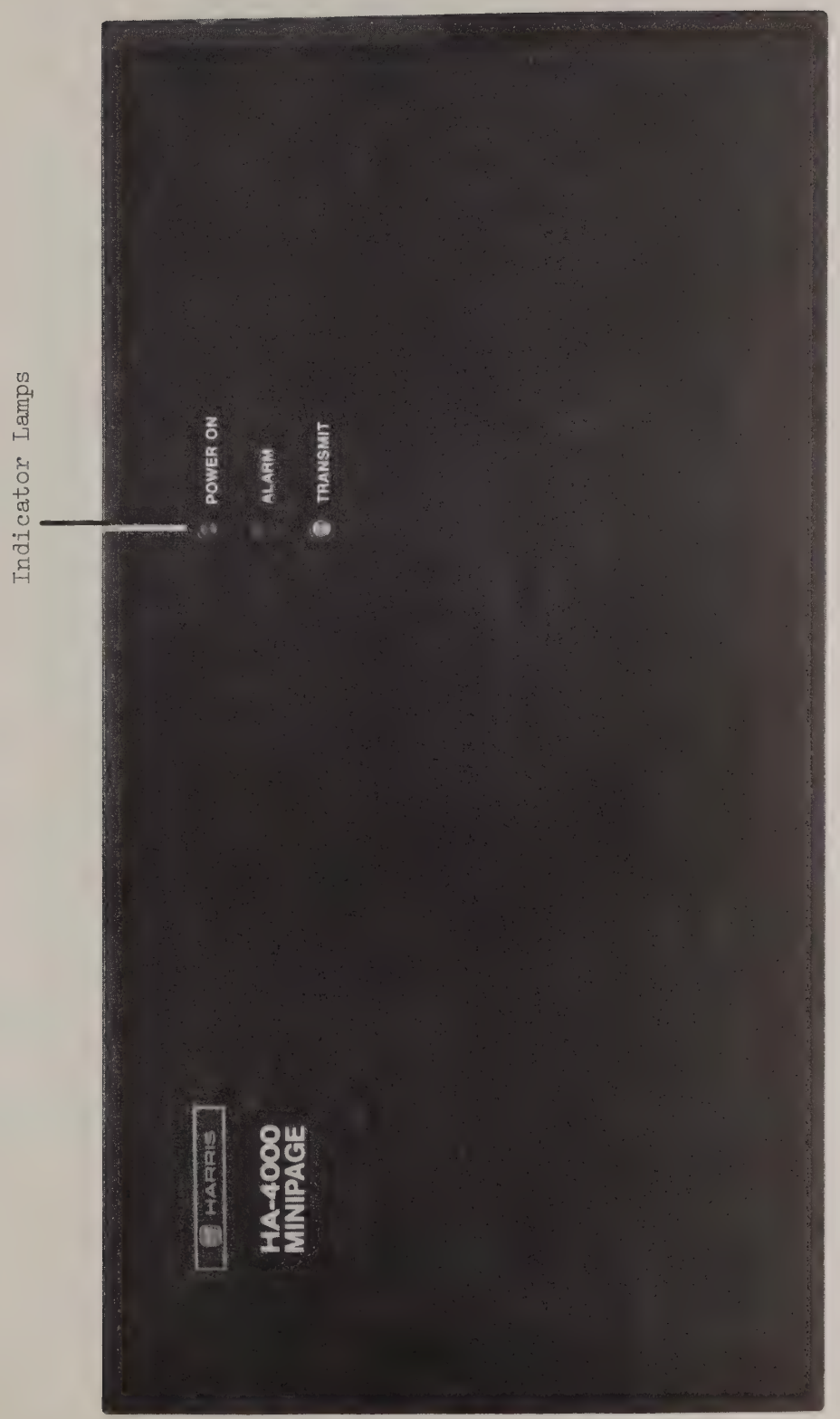



Figure 1-1. Minipage Terminal, Front View

# SECTION 2
# INSTALLATION

## A. GENERAL

The HA-4000 Minipage Terminal is designed to be installed by the customer. Installation consists of unpacking, unit and system checkout, and programming. The following test equipment is recommended for use in Minipage terminal checkout and alignment:

Volt-ohm meter, Simpson - Model 260, 270 or equivalent.
Storage oscilloscope, Tektronix - Model 434 or equivalent.
Flat blade and 1 Phillips screwdriver
Audio frequency meter
Audio voltage meter
Audio monitor
Signal generator

## B. UNPACKING

The Minipage terminal is shipped in two boxes containing the entire system consisting of the cabinet, console with cable and PC cards. Remove and unpack all components from the carton. Verify that all components ordered are included. Inspect each unit for shipping damage and notify the carrier immediately if damage has occurred.

## C. CABLE CONNECTIONS

WARNING:

Do not connect cables or apply power to the terminal until specifically instructed to do so.

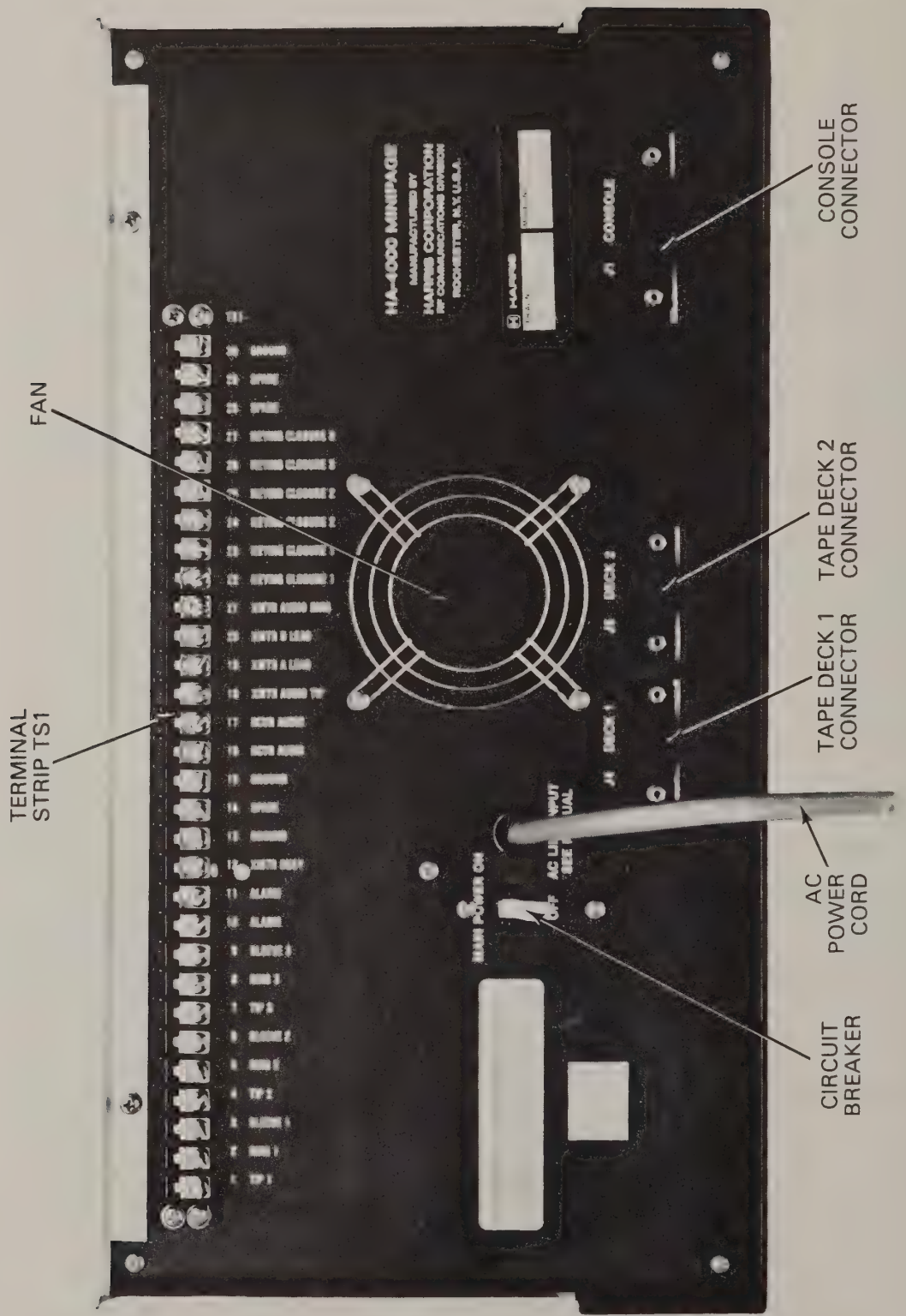



Figure 2-1. Minipage Terminal, Rear View

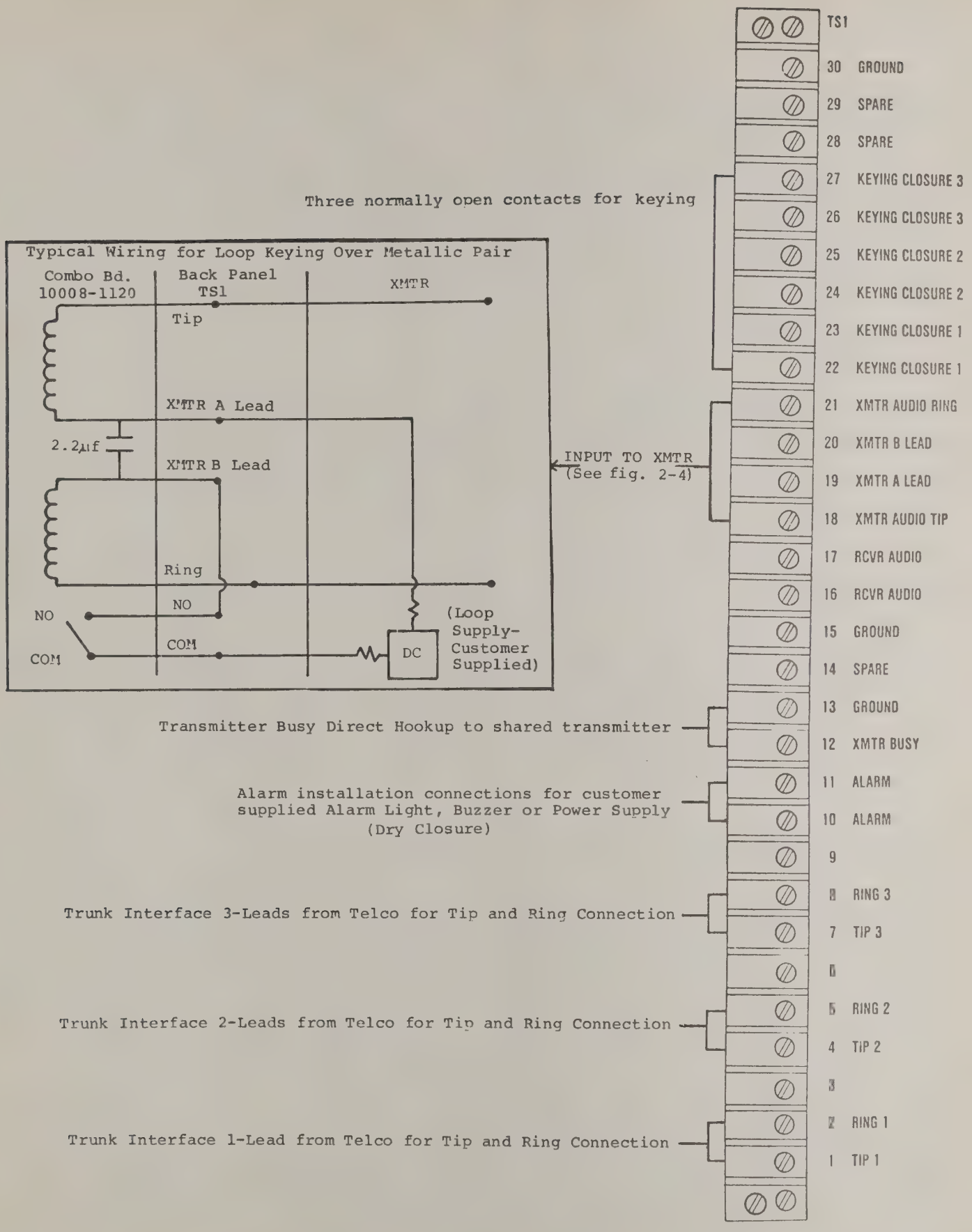



Figure 2-2. Typical Terminal Strip (TSI) Connections

## Extension Cable Option

If the optional extension cable is to be installed between the console and the HA-4000 Terminal, plug connect the extension cable into the cable from the console, and the other end into the "J1 CONSOLE" connector on the terminal back panel.

## Console Cable

To connect the console and its attached cable to the Minipage terminal (without the optional extension cable), plug the cable from the console into the "J1 CONSOLE" connector on the terminal back panel.

## Tape Deck Option

Remove packing material from unit, especially around fan. Connect the cable from the HA-4011 Tape Deck to the "J4 Deck 1" connection on the terminal back panel. If a second tape deck option is to be installed, connect its cable to "J5 Deck 2" connector on the terminal back panel.

## Terminal Strip (TS1) Connections (See figure 2-2)

Each trunk interface has a Tip and Ring connector for connecting the tip and ring leads from the Telco trunk line. These connections must be made before the terminal can process calls.

The alarm connectors (10, 11) on TS1 may be used by the customer to wire an alarm light, power supply, buzzer, etc.

The XMTR BUSY and adjacent GROUND connector (12, 13) may be connected to a normally open relay in a shared transmitter to signal the HA-4000 Minipage terminal that the transmitter is being used. (See Section 3. Operating Procedures.)

The XMTR AUDIO Tip and Ring connectors and leads (18-21) are connected to relay audio signals to the remote transmitter. A typical hook-up is shown in figure 2-4. The three (3) keying closures (22-27) may be used for direct keying of a dc loop, tone keying unit, or the transmitter keying relay.

D. CARD INSTALLATION (see figure 2-3)

The cabinet contains the power supply with the mother board, the combo card and sufficient slots for all options. Remove the cabinet top cover by removing the two phillips screws at the top rear of the cabinet. There are a total of 13 card slots. Slot number 1 is located towards the rear. The cards can only be installed with the component side to the rear. While any card will operate in any slot (except for physical clearance considerations), the following assignment is recommended:

| Slot No. | Card | Part No. |
|---|---|---|
| 1 | Trunk Interface #1 | 10008-1700 |
| 2 | No Socket | |
| 3 | Trunk Interface #2 | 10008-1700 |
| 4 | No Socket | |
| 5 | Trunk Interface #3 | 10008-1700 |
| 6 | No Socket | |
| 7 | Memory | 10008-1400 |
| 8 | CPU | 10008-1300 |
| 9 | DTMF Receiver | 10008-0100 |
| 10 | Tone Generator | 10008-1500 |
| 11 | Recorder Interface | 10008-0210 |

The shunt jumper, J1, on the Subscriber Memory card is placed on only one (1) pin of P3 to retain battery charge during shipping/storage. Before the Minipage terminal can be programmed, jumper J1 must be placed on both (2) pins of P3 to allow the batteries to charge and to provide memory retention during powerdown situations. The options must all be re-programmed (entered)

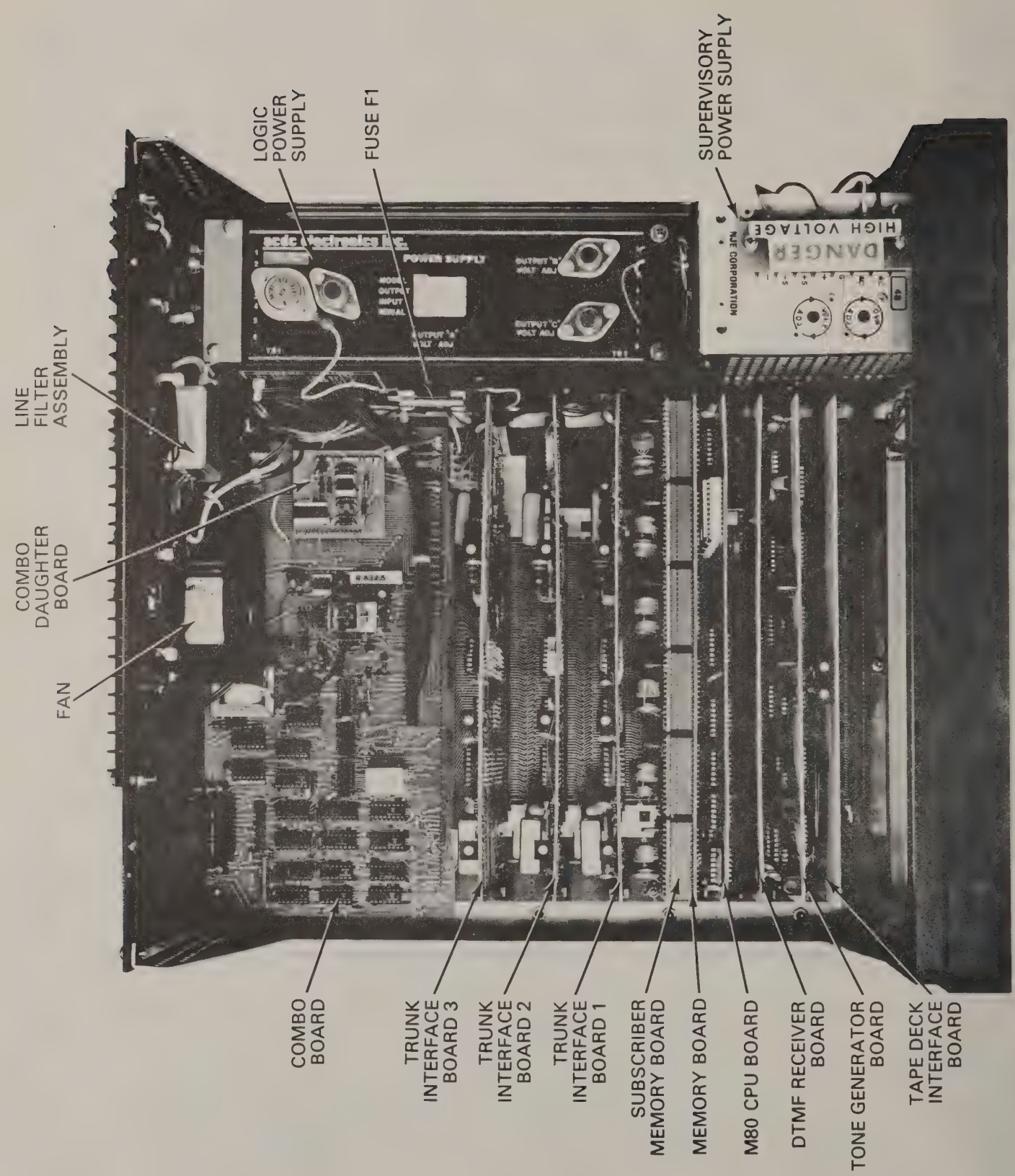



Figure 2-3. Minipage Terminal, Top View

through the main console since lack of power during shutdown/ storage wipes out all previous programming. The small Subscriber Memory card(s) must be installed on the Memory card. The Subscriber Memory card can be readily identified by its self-contained batteries and P/N 10008-1600. Each of these cards will store program data for 100 subscribers and, depending on the options ordered, from one to six of these cards may be installed. Installation must, however, proceed in consecutive order starting with location 1, which is located on the Subscriber Memory board on the upper right corner, when viewed from the component side. Note that the connectors have a key pin, and must be oriented correctly for proper installation.

Proceed with card installation as follows:

1. The ac circuit breaker located at the lower left rear of the cabinet, should be in the OFF position.

2. Install the CPU, Tone Generator and Memory cards. Do not install the Trunk Interface card(s) until the checkout procedure has been completed.

3. Connect the console cable to its mating connector, J-1 Console, located on the terminal back panel.

4. Insert the three prong ac plug, from the Minipage terminal, into a grounded three prong receptacle. This outlet should be on a separate circuit to minimize noise interference.

E. BASIC CHECKOUT

1. Switch the ac circuit breaker to the ON position. The Power indicators on the console and the front panel of the cabinet will turn on. The console display should be blank, although it may display CUE-1 if subscriber memory is not properly initialized. The CANCEL key will blank the display. Also, the Transmit indicators on the console and the cabinet will be on (Morse ID is being sent). Both of these indicators will turn off when the ID has completed.

2. Be certain the keyswitch on terminal back panel is in the ON (horizontal) position.

3. Enter the Test mode by depressing FUNC and 3 on the console keyboard. The Test mode indicator will turn ON.

4. Execute Tests 1 through 3 as follows:

TEST MODE FUNCTION: Tests 1 through 3

This mode is used to execute self-contained diagnostic tests and is entered by keying 'FUNC' and '3'. The test mode indicator will turn on. The display will have 'C' shown in the leftmost position. At this time, three tests can be executed by entering digits 1, 2 or 3 followed by 'ENTER'.

Test 1 is a test of the central processing system and the console subsystem.

The digit '8' will be displayed momentarily on each 7 segment display starting at the left. Note, the indicators will each turn on momentarily beginning with the manual indicator. When the test is completed, the test mode indicator will come back on and 'C' will be displayed on the left.

If while running the test, a call begins processing, the sequence in which the indicators light can be erratic depending upon the point in the test that the page processing begins. This, however, will not affect the overall test results.

Test 2 is a test of the tone generation system.

Test 2 exercises the tone generation hardware by sending a tone and verifying that the tone has been detected by the self-contained reed relay. If this test fails, the display will indicate CUE-2 and the unit should be checked by a qualified service technician. A successful test will complete in approximately one second and return with 'C' displayed.

Test 3 is a test of transmitter interface and ID circuitry.

Test 3 sends out the Morse code station identification. No further entries should be made until ID is complete. Note that the transmitter alarm will not be activated for failures while in the test mode and the console TRANSMIT indicator will not light.

NOTE

1. Alarm Contact

   A normally operated relay, having a single pole, single throw open contact, is wired to the rear terminal strip. The contact will close is one of the two following conditions occurs:

   a. If the processor fails to function.

   b. If any of the interal dc voltages drop as follows:

   If the dc voltages drop below factory set reference levels, the internal circuitry will detect a failure and close the alarm contact.

2. Self Test Failure

   If diagnostic test 2 of Test Mode fails signifying a tone generation failure, the alarm contact will close. In addition, an appropriate CUE message will be displayed on the console. If features 03 and 41 are active, the alarm contact will close if the transmitter is externally busy beyond the time defined by feature 41.

2. Self Test Failure (continued)

A CUE-1 message will be displayed if the subscriber memory test fails. This will most likely happen when the terminal is first unpacked and power is applied. While the terminal will autoamtically correct the error, the display should be cleared by pressing the CLEAR key or by turning power off and back on.

F. TRUNK CHECKOUT

Selector Level

1. Before inserting the trunk interface card, with a VOM, verify that voltage is not present on the trunk Tip and Ring from the Telephone Company.

2. From a local telephone, dial into the assigned selector group.

3. Enter all except the last two or three digits depending on whether it is a two or three digit selector feed.

4. Verify that there is still no voltage across the trunk. If a trunk has voltage present (probably 48 Vdc) call the Telephone Company and report the problem.

5. Locate the trunk by which you have accessed the terminal by checking to see which trunk has a resistance less than or equal to 1K ohm across the Tip and Ring.

6. Dial a 0 and the resistance reading should bounce with the dial pulses. The trunk so located, is the first trunk in the group and the Tip and Ring leads should be connected to Terminals 1 and 2 on the terminal strip (TS1) located at the top of the terminal back panel.

7. Return the local telephone, used in the test, to an on-hook condition. Connect the trunk Tip and Ring leads to terminals 1 and 2 on the terminal strip (TS1) located at the top of the terminal back panel.

1. Check to be certain that the line functions normally.

2. Remove the telephone instrument and connect that line to the Tip and Ring screws on the terminal strip (TS1).

Trunk Interface Card Initialization

Each Trunk Interface card has strapping plugs to identify the type of trunk (selector level or end-to-end) and the trunk position (1, 2, or 3).

| Trunk Number | Strapping Plug In |
|---|---|
| 1 | A6 |
| 2 | A5 |
| 3 | A4 |

Installation of more than one strapping plug in positions A6, A5, or A4, on the same card, is invalid. Installation of more than one card with plugs in the same location is also invalid.

| Trunk Type | Strapping Plug In |
|---|---|
| Selector Level | F5 |
| End-to-End | F6 |

1. Only one plug should be installed in either F5 or F6; not both.

2. The End-to-End option is normally shipped wired for bridged ringing.

3. However, if divided ringing (between Tip and ground) is desired, locate module F6 on the Trunk Interface card. Positioned just above F6, find the points labeled X, Y and Z in the upper left corner of the Trunk card.

4. Cut the jumper between Y and Z and add a jumper between points Y and X.

8. If the leads are reversed, terminal operation will not be affected. Using a Vom, verify that the loop current is between 25 and 30 milliamps. Incorrect loop current may cause false signaling between the minipage terminal and the Telephone Company. Refer to Section 4. Maintenance/ Troubleshooting, if difficulty is encountered.

9. Contact the Telephone Company if there is any question about the Tip and Ring polarity.

If more than one trunk is installed, it is necessary to busy the first trunk and call in on another phone to identify the second trunk. The same procedure will identify the third trunk. The above measuring procedure must be repeated for each trunk. The terminal strip connections are summarized below:

| Lead | Terminal Number |
|---|---|
| Trunk 1 Tip | 1 |
| Trunk 1 Ring | 2 |
| Trunk 1 Sleeve* | 3 |
| Trunk 2 Tip | 4 |
| Trunk 2 Ring | 5 |
| Trunk 2 Sleeve* | 6 |
| Trunk 3 Tip | 7 |
| Trunk 3 Ring | 8 |
| Trunk 3 Sleeve* | 9 |

*Reserved - no connection.

NOTE

Telephone Companies often supply Tip and Ring leads on outgoing trunks. Since the Minipage uses Tip and Ring only, the Telephone Company may provide the Sleeve termination in-plant, using the outgoing loop trunk circuits (such as Cook Electric Model 1250 or equivalent).

End-To-End

Proper operation of an end-to-end trunk can be verified by installing a conventional telephone instrument-in place of the terminal-to the subscriber line.

Trunk Interface Card Installation

1. Install the trunk interface card(s) in the proper slot(s).

2. Program the terminal features as defined in Section 3, E. Standard Programmable Features.

3. Program a typical subscriber.

4. Dial the subscriber and verify that the Transmit indicators turn on and the proper tones are heard over the phone. If an audio amplifier and speaker are available, connect the amplifier input-making sure that it is capacitively coupled to the transmitter interface audio output terminals and monitor the channel.

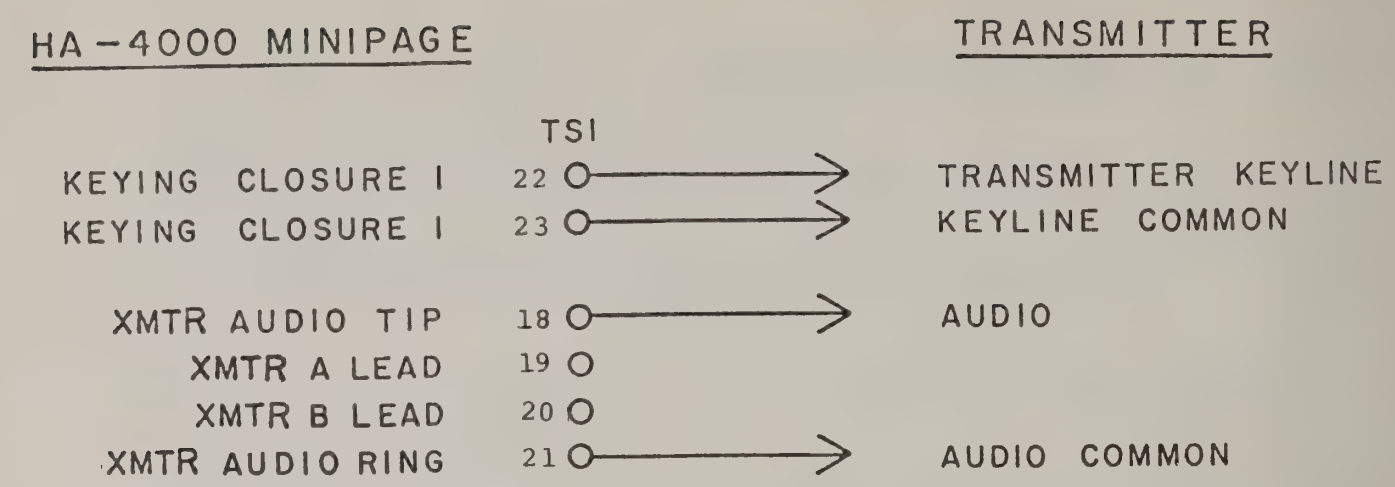
5. Call the same subscriber from the console and verify proper operation.

G. TRANSMITTER INTERFACE

The transmitter interface consists of keying and audio circuits. Three sets of normally open dry contacts are provided for keying. These six contacts are labeled KEYING CLOSURE 1, 2, and 3 on the rear terminal strip (TS1) on the terminal back panel. The audio output is provided on the four terminals labeled:

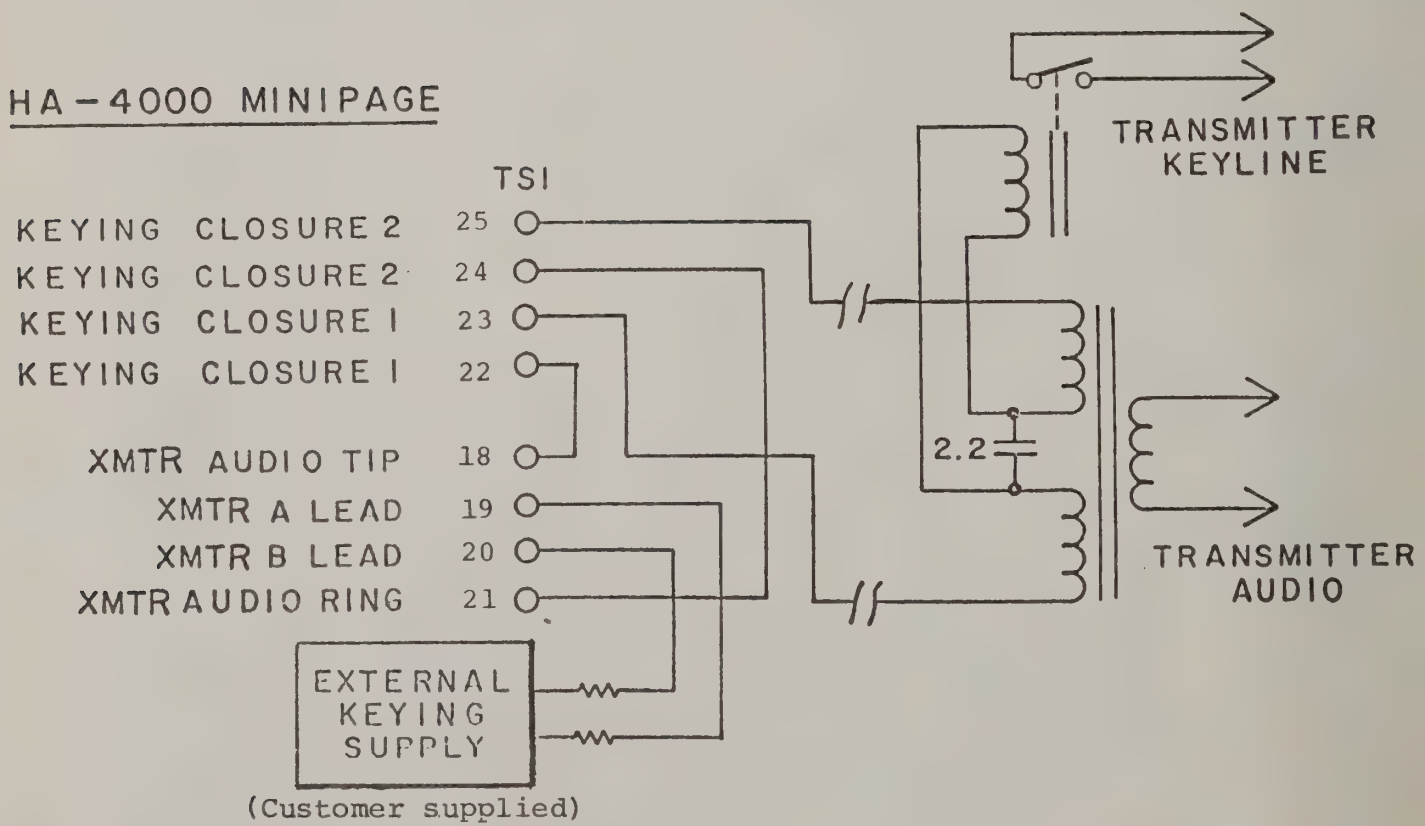
21 XMTR Audio Ring
20 XMTR B Lead
19 XMTR A Lead
18 XMTR Audio Tip

The interface consists partly of a transformer having a 900 ohm split winding that is capable of carrying 20 mA dc for keying. Two typical keying configurations are shown in figure 2-4.




A

LOCAL TRANSMITTER




B

REMOTE TRANSMITTER

Figure 2-4. Typical Keying Configurations

When transmitter installation is completed, operation should be tested by calling in from an external telephone, and by entering a page from the console.

## H. DC REMOTE INSTALLATION

The following information is provided to describe how the HA-4000 Minipage can be installed with Harris ST series base stations for tone-only or tone-and-voice paging. Two cases are given, one for local control and one for remote control. Note, that duty cycle for the ST series base station should not exceed 20% without forced air cooling.

For LOCAL CONTROL the following items are required:

1. A three-wire, 22 gauge jacketed cable. The four conductor cable, Harris P/N W-0954 or similar, can be used by cutting the green wire close to the jacket at both ends.

2. A plug (Harris P/N P-0505-6) that will mate with the microphone connector mounted on the ST series base station.

Refer to figure 2-4, and wire the cable to terminal strip (TS1), and to the plug as shown. Then insert the plug into the chassis socket and tighten the knurled ring.

For REMOTE CONTROL, the following items are required:

1. RF-4706 Dc Control Adapter. (See figure 2-5).

2. RF-4701 Extended Control Adapter Kit.

3. Dc loop power supply for transmitter keying. (Customer supplied).

4. A metallic telephone pair that provides dc continuity between the paging terminal and the base station.

Referring to figure 5-6, on manual IM-0307, and figure 2-3 of this manual, modify the RF-4706 Dc Control Adapter as follows:

1. Remove resistor R5 and replace it with a jumper.

2. Remove resistor R6 and replace it with a jumper.

Connect the telephone line tip and ring to terminals 1 and 2 on the RF-4706 Dc Control Adapter. Wire the Minipage back panel terminal strip (TS1), as shown in figure 2-4.

NOTE

1. The value of the current limiting resistor can be determined by the following:

   $R_{LIM} = 62\ V - (1550 + R_{LOOP})$

   Where: V is the dc loop power supply voltage in volts.

   $R_{LOOP}$ is the loop resistance of the cable pair between the paging terminal and the base station. This voltage should be limited to 270 volts between conductors and 135 volts between either conductor and ground.

   $R_{LIM}$ is the value of the current limiting resistor in ohms.

   FOR EXAMPLE:

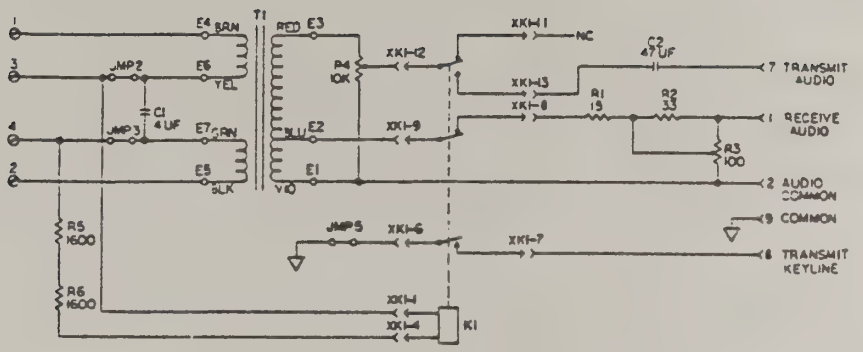
   Using a 48 volt power supply on 12 miles of 19 AWG cable,

   $R_{LOOP} = 1100$ ohms.

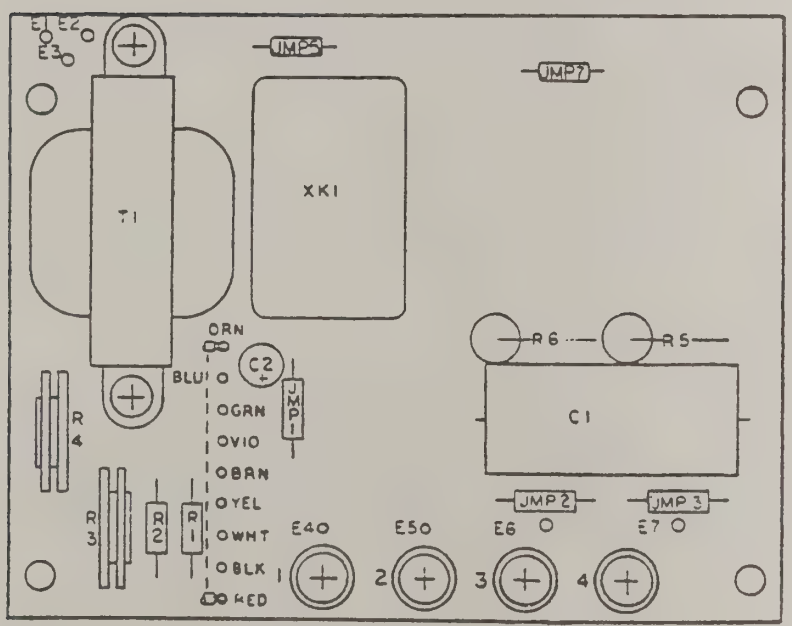
   Therefore, $R_{LIM} = (62 \times 48) - (1550 + 1100)$

   OR $R_{LIM} = 400$ ohms

2. Keying current limits are 15 mA minimum and 19 mZ maximum.




NOTES
1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTOR VALUES ARE IN OHMS.
2. RELAY K1 HAS A COIL RESISTANCE OF 1550 OHMS.
3. WIRING IS SHOWN FOR LINE-TO-LINE KEYING.




Part of ST-Base Station

Figure 2-5. RF-4706 Dc Remote Panel

## I. LEVEL ADJUSTMENTS

Level adjustments should be made in the following order:

1. Master Gain Control (Transmit Level) (P/O Combo Card P/N 10008-1120) (See figure 12 of manual PM-1666, Minipage Schematic Diagrams and Parts Lists.) Enter tone A page (i.e., ENTER through console, 010117575, which represents: address 10, Motorola two-tone pager, tone number 75). Approximately ten (10) seconds tone duration, with a frequency of 1006.9 Hz (tone code 75), will follow.

   Send the page manually from the console by depressing CANCEL and entering 010, followed by ENTER. While the tones are being sent, adjust R-11 on the combo board for proper audio level to the transmitter. This level, as measured at TS1, across XMTRA and XMTRB terminals should be between -15 and +5 dBm. If the transmitter connection is made via telephone company lines the audio levels should not exceed telephone company maximum, typically -10 dBm. If transmitter deviation will not adjust to ±3.5 kHz additional audio gain may be required. This gain should be installed at the transmitter, not at the terminal. Consult the telephone company if high line loss, or poor frequency response is suspected of causing transmission problems.

   After R11 has been adjusted, DO NOT re-adjust at any time during the remainder of the check-out procedures to follow. Be sure to note the line level for future reference.

2. Level from Telco

(See figure 24 of manual PM-1666, Minipage Schematic Diagrams and parts lists.) This adjustment is performed on each trunk card individually.

NOTE

AGC INPUT, R37, is factory set and should be adjusted only in cases where the incoming Telco levels range outside of -20 to +5 dBm.

a. Adjust R-38, LEVEL FROM TELCO, by entering a tone and voice page through the proper trunk card, and by setting the voice level equal to the tone level. Note that the tone level has been determined by previous adjustment of the MASTER GAIN CONTROL, R11, on the combo board in step 1 of this section. It will be helpful to program Feature 31, VOICE INTERVAL, to 10 which will allow 50 seconds of voice interval, during which time adjustments may be completed.

b. Adjust R-37, AGC INPUT, only if high Telco levels cause distorted audio to be transmitted, or if extremely low Telco levels produce inadequate modulation on the transmitter.

1. Connect an oscilloscope to the junction of R-36 and R-38 on the trunk card.

2. Enter a tone and voice page through the desired trunk and adjust R-37 for a reading of 2.4 V p-p, while talking very loudly into the telephone. There should be no visible distortion on the audio wave form and the audio level should be 2.4V p-p for wide variations in Telco audio levels.

3. Re-adjust R-38, LEVEL FROM TELCO.

3. Level to Telco (Supervisory Tones)

a. Adjust R-11, LEVEL TO TELCO, on each trunk card. Supervisory tones should be -20 dBm to ±5 dBm, measured at the Tip and Ring terminals (on TS1) for each trunk.

b. After all trunk cards installed have been adjusted, reprogram the voice interval (Feature 31) to the desired programmed value. (See Programmable Features/Function Reference chart in section 1).

4. Tone Generator Card

(See figure 22 of manual PM-1666, Minipage Schematic Diagrams and Parts Lists.) There are four potentiometers, R-33, R-26, R-20 and R-39 located at the top of the tone generator card (see figure 2-8). These are set and sealed at the factory and should not normally required further adjustment. In the event service is required on the tone generator card, it may be necessary to re-adjust the potentiometers. Use only a high stability frequency counter, such as HP-5307 or equivalent, and proceed as follows:

Connect the frequency counter to pin 1 of the indicated IC and adjust the associated potentiometer. The signal should be an undistorted since wave of approximately 1.5V p-p.

| POT | TEST POINT | FREQUENCY | RANGE |
|---|---|---|---|
| 1 (R-33) | IC G5 Pin 1 | 440 Hz | ±1 |
| 2 (R-26) | IC G4 Pin 1 | 480 Hz | ±1 |
| 3 (R-20) | IC G2 Pin 1 | 620 Hz | ±1 |
| 4 (R-39) | IC G1 Pin 1 | 1400 Hz | ±5 |

# SECTION 3
# OPERATING PROCEDURES

## A. GENERAL

Calls are received by the terminal via one of the three possible trunk interfaces or the console. Data at the trunk interface may take the form of dial pulses or DTMF tones. Data entered from the console is in the form of machine-compatible logic pulses.

## B. SELECTOR LEVEL INPUT

### General

The trunk interface is connected to the fourth (or fifth) selector level in a telephone central office. The calling party dials a standard seven digit number. The last three (or two) digits of this number are presented to the trunk interface.

If the calling party dials a number that has not been programmed in subscriber memory, reorder busy is returned and reverse battery does not occur. If the wrong number message recorder option is installed, that message will be heard followed by reorder busy.

If the calling party dials a valid number, different actions occur depending on the status of the terminal and type of call. Once reverse battery occurs it is held for a minimum time of six (6) seconds.

### Tone-Only-Call

The calling party hears two seconds of ringing followed by at least one second of silence. The silence is followed by an instructional or advertising message if that option is installed.

If the page is valid and the tone only memory is not full, reverse battery occurs followed by 0.5 seconds of a 1400 Hz tone. Once reverse battery occurs it is held for a minimum of six (6) seconds regardless of what the calling party does. Five seconds of silence, during which the calling party should hang up, follows the tone, and then reorder busy is sent. If the calling party has not already hung up, reverse battery is dropped.

Tone-and-Voice Call

The calling party hears two seconds of ringing followed by at least one second of silence. The silent period is followed by an instructional or advertising message if that option is installed. If the page is valid and the transmitter is free, reverse battery occurs and the tones are transmitted. Ringback cycles of two seconds of ringing and four seconds of silence occur until the voice interval begins at which time the calling party will hear a 0.5 second 1400 Hz tone. The voice path is maintained for an adjustable time period of five to 50 seconds. A second 0.5 second 1400 Hz tone is sent as warning, five seconds before the end of the voice interval. At the end of the voice interval reorder busy is returned for five seconds after which, reverse battery is dropped.

If the transmitter is busy, the ringback cycle continues until the transmitter is free or until the camp-on interval expires.

In all modes of operation with a selector level trunk interface, the calling party controls the sequence of events. If the calling party hangs up after all digits have been entered, but before the tones are sent, one of two of the following events occurs:

| | |
|---|---|
| Tone-Only Call | - the page is sent. |
| Tone-and-Voice | - the call is cleared and no page is sent. |

If the calling party fails to enter all the required digits, an interdigit abandonment interval controls events. This interval is variable from five to 50 seconds in five second increments. When the interval completes, reorder busy is returned and reverse battery will not occur.

## C. END-TO-END INPUT (DUAL-TONE MULTIFREQUENCY)

### General

The End-to-End Interface connects to a subscriber telephone line. The calling party dials a normal seven digit telephone number. A minimum of two seconds of silence is followed by a 1400 Hz tone at seizure.

The calling party must then enter the three digits assigned to the subscriber to whom the call is intended.

The terminal requires only a three digit number (optionally two digits) to uniquely identify all 600 possible subscribers. An optional fourth digit may be used as a parity digit to check the accuracy of the first three received digits. If the calling party incorrectly dials the number, or the digits are received in error at the terminal, the terminal will detect that error. In this case, the calling party is returned a unique chirp signal (produced by high speed on-off keying of a 1400 Hz tone) for one second. This procedure may be repeated twice. Thus, the calling party has three chances to enter the four digit subscriber number without having to re-dial the seven digit number. At the end of the third try the chirp is followed by reorder busy or the optional instructional message.

If the calling party enters the three (or four) digit subscriber number correctly, and it is received without error, it still may be an invalid number; i.e., programmed in memory as invalid. In

this case reorder busy is returned to the calling party. If the wrong number message recorder option is installed, this message will be heard followed by five seconds of silence and reorder busy. After five seconds of reorder busy, the terminal will "hang up". Whenever this happens, the calling party may hear immediate or delayed dial tone or nothing, depending on the particular central office. If less than three (or four) digits are entered, the terminal will hang up after the interdigit abandonment interval has completed. This interval is variable from five to 50 seconds in five second increments.

If the calling party correctly dials a valid number and that number is received correctly, different events occur, depending on the status of the terminal and type of call. In each case the instructional or advertising message will be heard first if that option is installed.

Tone-Only Call

If the tone only memory is not full, the calling party hears a 0.5 second 1400 Hz tone followed by terminal hang up, indicating that the call was put through.

Tone-and-Voice Call

If the transmitter is not busy, the calling party hears ringing while the tones are being transmitted, and then a 0.5 second 1400 Hz tone that signifies the page has been transmitted and a voice path has been established.

This voice path is maintained for the voice interval which is adjustable for from five to 50 seconds in five second increments. Five seconds prior to the end of the voice interval another 0.5 second 1400 Hz tone is sent. Reorder busy is returned at the end of the voice interval and five seconds later the terminal hangs up.

If the transmitter is busy, camp-on ringing is initiated. Ringing continues until the transmitter is free or the camp-on interval completes. If the transmitter becomes free, the 0.5 second 1400 Hz tone is heard and events proceed as described in the preceding paragraph. If the camp-on interval ends, reorder busy is returned for five seconds followed by terminal hang up.

## D. CONSOLE

### General

The Minipage console has five major functions: terminal features definition, test mode, programming subscriber memory, monitoring and manual input. The console layout is illustrated in figure 3-1 and consists of 12 keys, nine LED (Light Emitting Diode) indicators, nine seven-segment LED displays and two key switches at the rear of the console.

### Function Indicator Lamps (see figure 3-1)

POWER ON - This indicator is on whenever primary power is applied to the terminal.

MANUAL MODE - The Manual Mode indicator is on when the console is being used to send pages.

SUBSCRIBER MODE - This indicator is on when the console is in Subscriber Mode. The Minipage must be in this mode to be able to read from and write to (ENTER) Subscriber Memory.

ACCOUNTING MODE - The Accounting Mode indicator is on when the Call Counter Option is installed and the counters are to be read or written.

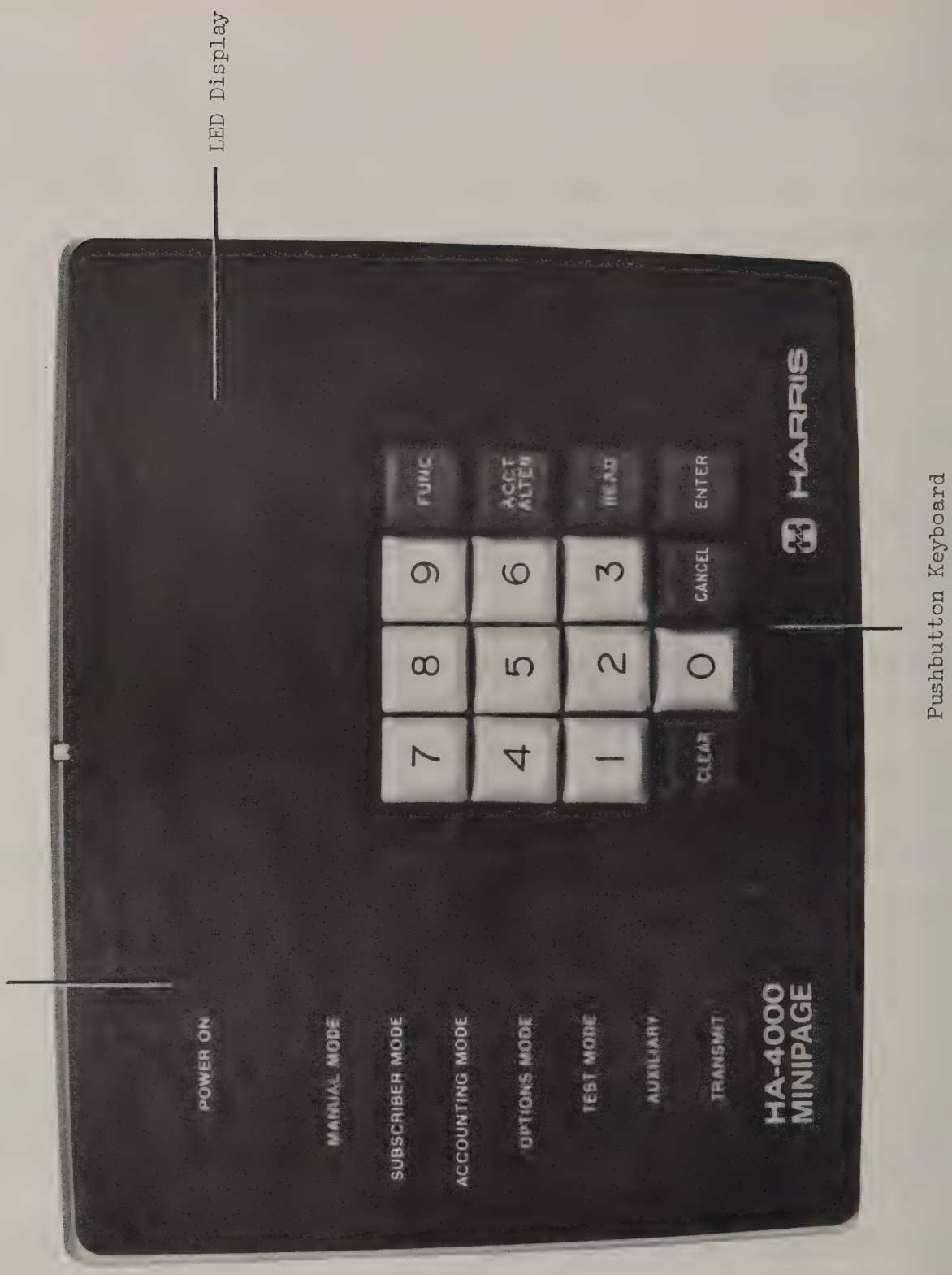



Figure 3-1. Minipage Console, Front View

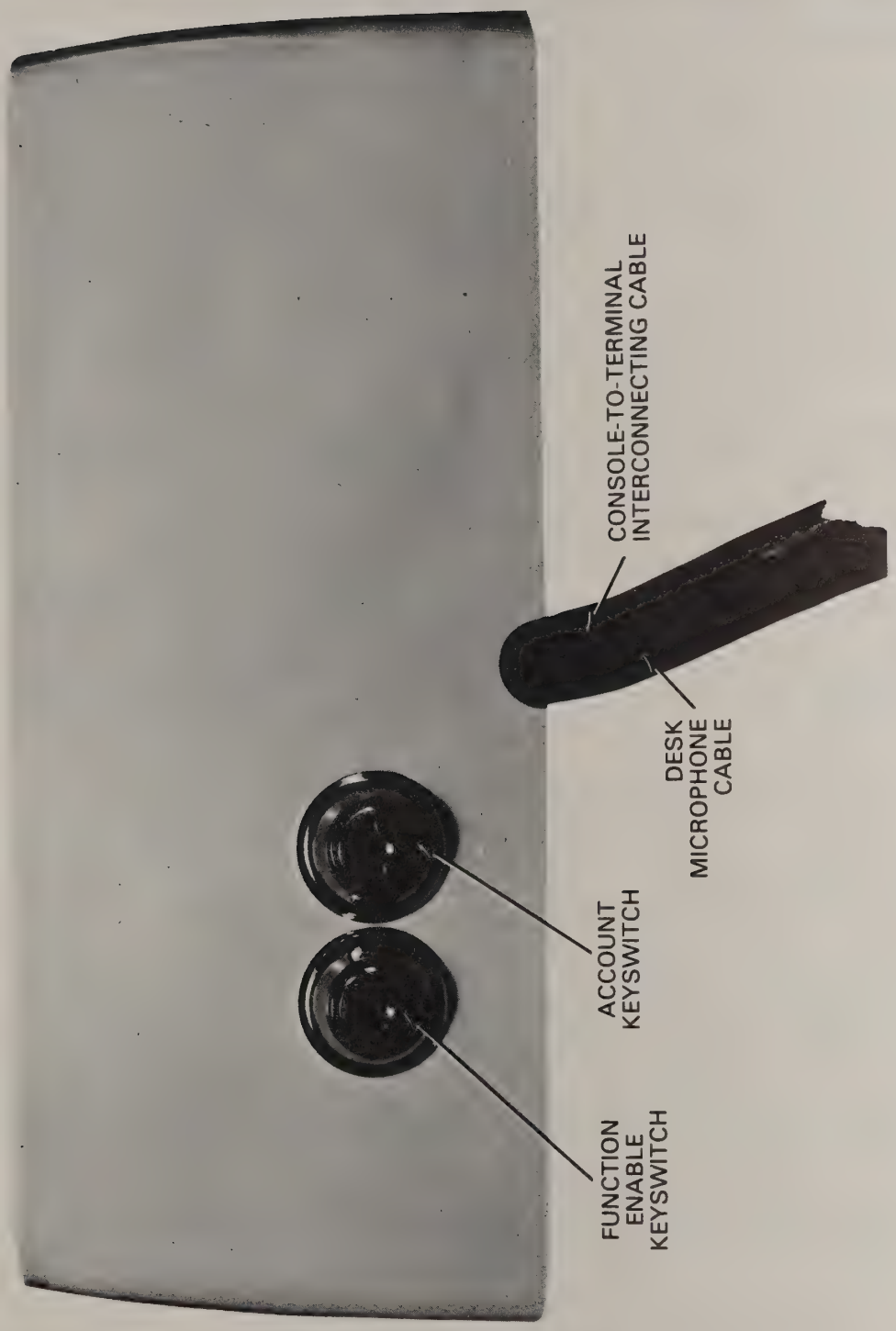



Figure 3-2. Minipage Console, Rear View

OPTIONS MODE - The Options Mode indicator is on when defining the terminal programmable features.

TEST MODE - This indicator is on when the console is being used to run diagnostics.

AUXILIARY - This indicator is not used.

TRANSMIT - This indicator is on whenever the transmitter is keyed by the terminal.

Keyswitches

The keyswitches have the following functions:

0 - 9 Used to enter numeric data.

CLEAR - Clears the display and internal buffer of previously entered numeric data. Data may be cleared at any point prior to depressing ENTER.

ENTER - Used to signal the completion of a keying sequence.

FUNCTION - The Function key is used in conjunction with a numeric key to enter the various modes.

CANCEL - Used to exit modes and terminate operations in process. The console is put in the monitor mode after depressing this key.

READ - Used to display the contents of subscriber, call counter or options memory. Repeated depressions automatically increments the address thus displaying the contents of the next highest memory location.

ACCT. ALTER - The Accounts Alter key is only used when writing data into a calling counter. It is depressed after entry of the numeric data and before ENTER. It is active only in Accounting Mode.

Display

The nine position seven-segment display is used to display entered data memory contents, and system activity in the Monitor Mode. In addition to the ten number, 0-9, the following characters may be displayed:

C - Displayed when the console is being used for manual input and reorder busy is being returned.

E - Displayed when a keying sequence or field length error is made.

F - Displayed when a memory location is read that was previously programmed with a format error.

U - Displayed when a memory location is addressed that has not been programmed, has been invalidated, or is not installed.

-- Is displayed when the console is being used for manual input during the voice interval.

Rear of Console Keyswitches ( see figure 3-2)

The keyswitch on the left, looking from the rear of the console, is used to inhibit the FUNC key. With this keyswitch off (vertical position), only Monitor and Manual Modes may be entered. The keyswitch on the right, looking from the rear of the console, inhibits the ACCT. ALTER key (when in the vertical position), thus call counter information cannot be manually altered.

Operating the Console

The operator should be familiar with chart 3-1, Table 3-1 and the descriptions of Programmable Features in Section 3 E, following.

ENTER an identifying two-digit feature number (e.g. 01). These two digits will appear in the two leftmost positions on the display. Then, press the READ key. The value to which that feature has been set will appear in the two rightmost positions on the console display.

To modify that value, press the two numerical keys corresponding to the desired new value. As these keys are pressed, their numbers will replace those in the two rightmost positions of the display. Press the ENTER key and the desired new value will replace the previously programmed value in the memory.

If that is the only feature to be altered or checked, press the CANCEL key and the console will return to the monitor mode. However, if more re-programming is to be done, pressing the READ key instead of CANCEL, will advance the program to the next higher option address, which may then be operated as just described.

To re-program a feature whose address number is impractical to access by sequentially pressing the READ key, press the CLEAR key returning the console to the point of just entering the options mode (Function 4). That is the console is still in the options mode and the new feature number may be entered followed by READ etc. as previously described.

## E. STANDARD PROGRAMMABLE FEATURES

Most of the Minipage Programmable Features are defined by keyboard input at the console. After initial power on, the Power indicator will be on and all other indicators will be off after the Morse ID is sent. This is defined as the Monitor Mode and if in this mode, when the system is operational, transmitter activity is displayed.

The Minipage has a phantom digit capability (Feature 04, 05 and 06 for Trunk 1, 2 and 3 respectively) that is useful for making 100 number blocks which use a two-digit feed (00-99) compatible with the three digit requirement on selector level operation. That is, it is not necessary to purchase or lease numbers in 1000 number blocks in order to obtain a three-digit feed. The phantom digit can be 0 to 5, permitting any incoming 100 number group to address any group of 100 numbers in memory. Features 04 and 71 enable the phantom digit for Trunk 1.

The phantom digit must not be confused with the trunk offset digit (feature 84 for Trunk 1). The phantom digit is inserted ahead of a two-digit selector level feed while the offset digit is added to the first digit of a three digit selector level feed to reposition a three digit number group.

For example:

| Phantom Digit 1 | Offset Digit 3 |
|---|---|
| Dialed 22 | 822 |
| Result 122 | 122 |

The Features are preset at the factory as presented in Table 3-1, Programmable Features/Functions. A duplicate listing is provided for User convenience in Section 1, E. If any of these programmable features are unsuitable, the Options Mode must be entered to change them. To do this, the leftmost keyswitch (viewed from the rear) Function Enable, must be in the horizontal position (see figure 3-2). Depress the FUNC key and '4' key. The Options Mode indicator will turn on indicating the system is in the Options Mode, and the Standard Programmable features may be entered and/or changed in this mode.

00 - Preamble Required if the preamble feature is specified, all five-tone pages will be sent with a 690 ms. preamble having a frequency equal to the first tone. This feature is only applicable to 5/6 tone signaling and is factory set to "1" which enables

the option. All 5/6 tone signaling will include preamble. Entry of a "0" will disable preamble.

01 - 5/6 Tone-Over-Voice

This feature is factory set to "0" which disables the option. Entry of a "1" will allow 5/6 tone signaling to be sent tone-over-voice. See feature 70 for special conditions that occur when a 5/6 Tone-Over-Voice page is initiated on a priority basis.

02 - Console Voice

This feature is factory set to a "0" for no console voice, and must be set to "1" for console voice. (The console voice option must also have been purchased with the unit.)

03 - Transmitter Alarm Enable

This feature determines whether option 41 is enabled and is factory set to "0" which disables the transmitter alarm. If a 1 is entered the alarm is enabled (see feature 41 for details).

04 - Trunk 1 Phantom/Offset Select

00 = Offset, 01 - Select

05 - Trunk 2 Phantom/Offset Select

00 = Offset, 01 = Select

06 - Trunk 3 Phantom/Offset Select

00 = Offset, 01 = Select

On Selector Level operation, if only two digits are to be entered, a Phantom Digit is required. Each individual trunk must have the digit one position offset by a number (or zero) or phantomed by a predetermined number.

Features 04, 05 and 06 are used to determine whether Trunks 1, 2 or 3 respectively are offset or phantomed (00 = offset and 01 = phantom.)

Features 71, 72 and 73 are used to determine the digit to be phantomed into the digit one position of Trunks 1, 2 and 3 respectively, if phantoming is selected by features 04, 05 or 06.

Features 84, 85 and 86 are used to determine the digit to be added (offset) to the digit one position of Trunks 1, 2 or 3 respectively, if offset is selected by features 04, 05 or 06.

| | | | |
|---|---|---|---|
| Example: | 04 = 00 | 84 = 00 | Trunk 1 Offset by zero (do nothing) |
| | 05 = 00 | 85 = 04 | Trunk 2 Offset by 4 |
| | 06 = 01 | 86 = 03 | Trunk 3 Phantomed with 3 |

Using this example, entering 157 would address the following subscriber memory addresses:

| Trunk | Address |
|---|---|
| 1 | 157 |
| 2 | 557 |
| 3 | 357 |

07 - Morse ID Required

This feature enables the standard morse identification. It is factory preset to 1. If both the voice ID (option 62) and Morse ID are enabled, only the Morse ID will occur.

01

10 - Parity Checking Required

Parity Checking is only applicable to end-to-end trunks. If no phantom digit is used, three digits would normally be entered. With feature 10 enabled (01), a fourth digit must be entered to allow the terminal to check the accuracy of the number. The value of the fourth digit is calculated as follows:

Dialed Number = ABC
Fourth digit = Y
2A + B + 2C = XY (X is ignored)

Example: Address = 123
Y = 2 + 2 + 6 = 10 use 0
Dial: 1230

30 - Camp On Ringing Time

Calls manually entered from the console or any trunk, when the transmitter is busy, will ring for a set time period before disconnecting the calling party.

The ring time is adjustable in ten second increments. Ten times the numeric value entered, equals the wait time; i.e., if 03 is the value, 30 seconds is the wait time. The wait time is factory set to 30 seconds. Any entry from 01 to 10 is valid (10-100 seconds).

31 - Voice Interval Time

This feature defines the duration of the voice interval for tone-and-voice pages and is factory set to 03 (15 seconds). The interval is adjustable from five to 50 seconds in five second increments by entering values from 01 to 10.

32 - Duration of First Tone

The duration of the first tone on audible two-tone signaling is factory set to one second (02). The duration is adjustable from .5 second to 5 seconds in .5 second increments by entering values from 01 to 10. 01

33 - Duration of Intertone Gap

The duration of the break between tones on audible two-tone signaling is factory preset to 10 automatically. It is adjustable from .05 seconds to .5 seconds in .05 second steps by entering values from 01 to 10.

01

34 - Duration of Second Tone

The duration of the second tone on audible two-tone signaling is factory set to three seconds (06). It is adjustable from .5 seconds to five seconds in .5 second increments by entering values from 01 to 10. 01

35 - Duration of Tone-to-Voice Interval

The interval between the tone period and the voice period for tone and voice signaling is factory set to 1.5 seconds (03). It is adjustable from 0.5 seconds to 5 seconds in 0.5 second steps by entering values from 01 to 10.

36 - Duration of First Subaudible Tone

The duration of the first tone on sub-audible two-tone signaling is factory set to one second. The duration is adjustable from .5 seconds to 5 seconds in .5 second increments by entering values from 01 to 10.

37 - Duration of Intertone Subaudible Gap

The duration of the break between tones on sub-audible two-tone signaling is factory set to .5 seconds. It is adjustable from .05 seconds to .5 seconds in .05 second steps by entering values from 01 to 10.

38 - Duration of Second Subaudible Tone

The duration of the second tone on sub-audible two-tone signaling is factory set to three seconds. It is adjustable from .5 seconds to five seconds in .5 second increments by entering values from 01 to 10.

39 - Number of Page Transmissions

This feature defines the number of times tone signaling will be sent and is factory set to 1 (01). Adjustment may be from one to ten by entering values from 01 to 10. Thus, pages may be sent up to ten times. This feature applies only to two-tone signaling schemes.

40 - Transmitter Carrier Delay Time

This feature defines the delay time between transmitter keying and the start of signaling and is factory set to .5 seconds (05) and is adjustable from .1 to one second in .1 second steps by entering values from 01 to 10.

41 - Transmitter Alarm Time

This feature defines the time the transmitter must be externally busy before the Alarm circuit is turned on. It is factory set to two minutes and is adjustable from two to 20 minutes in two-minute increments by entering values from 01 to 10. To enable, see feature 03.

42 - Interdigit Abandonment Time

This feature defines the time the terminal will wait between digits being dialed and is adjustable in five-second increments from five to 50 seconds. It is factory set to five seconds (01).

43 - ID Timer

This feature defines the time between identification transmissions and is adjustable in five-minute increments from five to 50 minutes. It is factory set to 20 minutes (04). 10

44 - Speed of Morse ID

Feature 44 is used to set the Morse code speed in words-per-minute (wpm) and is adjustable in 2.5 wpm increments from 2.5 to 25 wpm. It is factory set to 25 wpm (01).

45 - Number of ID Transmissions

This feature determines the number of times the station identification is repeated and is adjustable from 01 to 10. It is factory set to 01 (ID transmitted once).

60 - Ad Message Required

NOTE

Only two recorder options can be enabled at one time.

This feature is set to 01 or 02 if the ad message recorder option is installed and is factory set to 0 if there is no option. The 01 or 02 designates the position in which the recorder is installed.

01 = Deck 1 Jack, 02 = Deck 2 Jack

61 - Wrong Number Message Required

Feature 61 is set to 01 or 02, depending on the position of the recorder, if the wrong number message option is installed. The feature is factory set to 0 if there is no recorder.

01 = Deck 1 Jack, 02 = Deck 2 Jack

62 - Voice ID Required

This feature is set to 01 or 02 if the voice ID recorder option is installed. The 01 or 02 denotes which of the two possible recorder positions is to be used for voice ID. The feature is factory set to 0 if this option is not to be installed.

01 = Deck 1 Jack, 02 = Deck 2 Jack

70 - Priority Trunk

This feature defines the trunk interface, or console, to be given priority. The valid entries are:

| | |
|---|---|
| 00 | Console |
| 01 | Trunk Interface 1 |
| 02 | Trunk Interface 2 |
| 03 | Trunk Interface 3 |
| 04 to 09 | No Priority |

This feature is factory set to 04 - no priority.

It should be noted that in a system utilizing 5/6 Tone-Over-Voice or subaudible tone-and-voice signaling, such a page when initiated on a priority trunk or from the console will not be processed as Tone-Over-Voice. Instead, it will be sent immediately following the current page without regard to any pages in queue.

71 - Trunk 1 Phantom Digit

Feature 71 is used in conjunction with Option 04 to define the required phantom trunk digit. Any digit from 0 to 5 may be phantomed by entering values 00 to 05. This feature is factory set to 00.

72 - Trunk 2 Phantom Digit

This feature is used in conjunction with feature 05 for trunk 2 and is otherwise, the same as feature 71.

73 - Trunk 3 Phantom Digit

This feature is used in conjunction with feature 06 for trunk 3 and is otherwise, the same as feature 71.

80 - Minimum Connect Time (First Seizure)

Feature 80 is used to define the minimum time a trunk interface will maintain reverse battery on a selector level trunk and is adjustable in one second increments from 6 to 16 seconds. It is factory set to 6 seconds (00).

84 - Trunk 1 Offset

This feature applies only to selector level feeds. It has no effect on an End-to-End trunk and cannot be used with a two-digit feed selector level (a two-digit feed selector level requires a phantom digit). The trunk 1 offset digit programmed in this location is added to the first dialed digit received and the resulting number is used as the page address. For example, if the offset programmed is 01 and the number dialed is 012, the page at location 112 is sent. Since the subscriber memory runs from 000 to 599, the offset feature can be used to reposition a particular selector feed to the block required by the subscriber memory. For example, assuming an incoming subscriber block of 800-899, an offset of 02 would address pages in the block 000-099. This feature is factory set to 00. = -05 = 600

85 - Trunk 2 Offset = -05 = 600

This feature is the same as 84 except that it applies to trunk 2.

86 - Trunk 3 Offset

This feature is the same as 84 except that it applies to trunk 3.

Table 3-1. PROGRAMMABLE FEATURES/FUNCTIONS

| Programmable Feature Number | Function | Enter | Factory Set To |
|---|---|---|---|
| 00 | Preamble Required | 0 = No<br>1 = Yes | 0 |
| 01 | 5/6 Tone as Tone-Over-Voice | 0 = No<br>1 = Yes | 0 |
| 02 | Console Voice | 1 = Yes | |
| 03 | Transmitter Alarm Enable | 0 = No<br>1 = Yes | 0 |
| 04 | Trunk 1 Phantom Digit Required | 0 = No<br>1 = Yes | 0 |
| 05 | Trunk 2 Phantom Digit Required | 0 = No<br>1 = Yes | 0 |
| 06 | Trunk 3 Phantom Digit Required | 0 = No<br>1 = Yes | 0 |
| 07 | Morse ID Required | 0 = No<br>1 = Yes | 1 |
| 10 | Parity Checking Required | 0 = No<br>1 = Yes | 0 |
| 30 | Camp On Ringing Time | 01-10 | 03 |
| 31 | Voice Interval Time | 01-10 | 03 |
| 32 | Duration of First Tone | 01-10 | 02 |
| 33 | Duration of Intertone Gap | 01-10 | 10 |
| 34 | Duration of Second Tone | 01-10 | 06 |
| 35 | Duration of Tone to Voice Interval | 01-10 | 03 |
| 36 | Duration of First Subaudible Tone | 01-10 | 02 |
| 37 | Duration of Intertone Subaudible Gap | 01-10 | 10 |
| 38 | Duration of Second Subaudible Gap | 01-10 | 06 |
| 39 | Number of Page Repeats | 01-10 | 01 |

| Programmable Feature Number | Function | Enter | Factory Set To |
|---|---|---|---|
| 40 | Transmitter Carrier Delay Time | 01-10 | 05 |
| 41 | Transmitter Alarm Time | 01-10 | 01 |
| 42 | Interdigit Abandonment Time | 01-10 | 01 |
| 43 | ID Timer | 01-10 | 04 |
| 44 | Speed of Morse ID | 01-10 | 01 |
| 45 | Number of ID Transmissions | 01-10 | 01 |
| 60 | Ad Message Required | 00-02 | 00 |
| 61 | Wrong Number Message Required | 00-02 | 00 |
| 62 | Voice ID Required | 00-02 | 00 |
| 70 | Priority Trunk | 00-05 | 04 |
| 71 | Trunk 1 Phantom Digit | 00-05 | 00 |
| 72 | Trunk 2 Phantom Digit | 00-05 | 00 |
| 73 | Trunk 3 Phantom Digit | 00-05 | 00 |
| 80 | Minimum Connect Time (6 sec min) | 00-10 | 00 |
| 84 | Trunk 1 Offset | 00-09 | 00 |
| 85 | Trunk 2 Offset | 00-09 | 00 |
| 86 | Trunk 3 Offset | 00-09 | 00 |

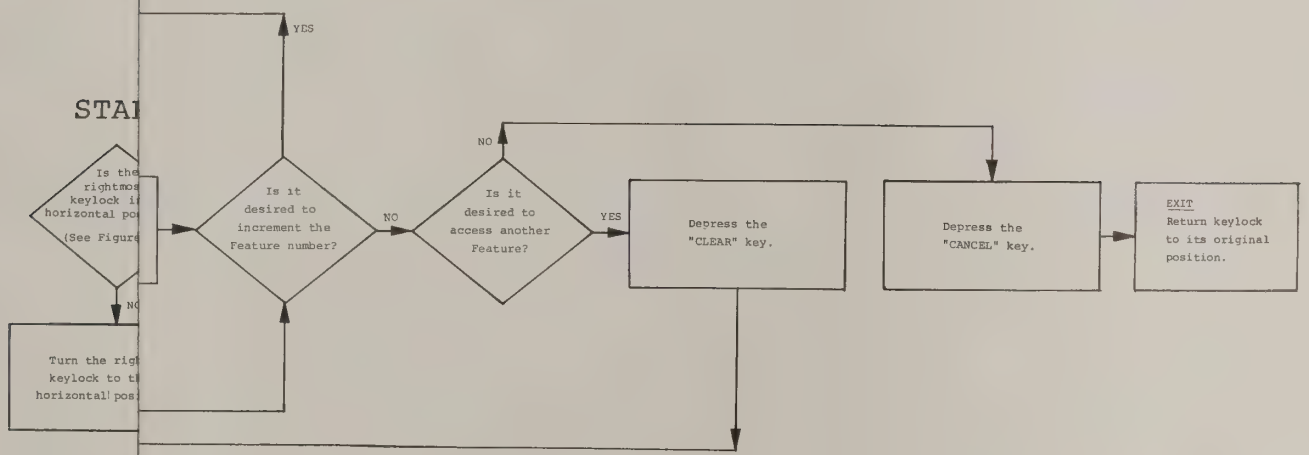



Chart 3-1. Flow Chart for 'FUNC 4', Features Programming

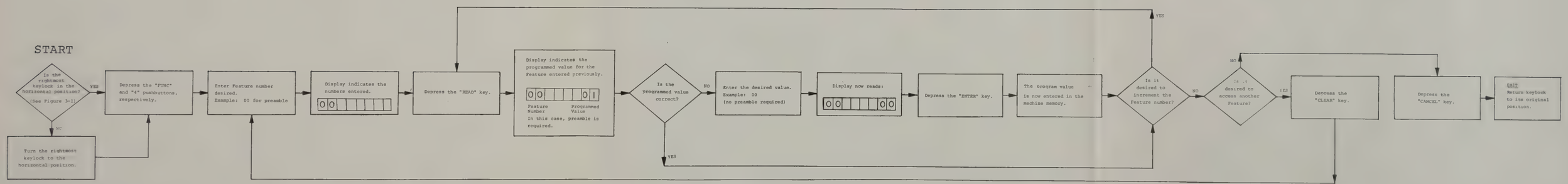



Chart 3-1. Flow Chart for 'FUNC 4', Features Programming

F. PROGRAM

To program subscriber memory, the system must be in the subscriber mode. If the system is in Monitor Mode, depress FUNC and 1. If the system is in any other mode, depress CANCEL, FUNC and 1. The Subs Mode indicator will come on.

There are three possible error conditions that can occur in Subscriber Mode:

Undefined - An error message of all U's is displayed. This will occur if an address of memory is entered that is not installed.

Format - An error message of all F's will be displayed. This error is caused by entering invalid digits after the address.

Sequence - An error message of all E's will be displayed. This error is caused by entering function keys out of sequence or more digits than are required.

Programming is summaried in Table 3-2 which is basically the HA-4000 Minipage Programming Card and is explained in the following paragraphs.

After entering the Subscriber Mode as described previously (FUNC and 1) the first three digits to be entered are the address. Addresses 000 through 099 are valid. If additional subscriber memory is installed, addresses 000-199, 000-299, 000-399, etc. will be valid depending on how much memory is installed. Addresses entered for uninstalled memory will result in an undefined error. As the address digits are entered they are displayed. The contents of memory may then be displayed by depressing the READ key. Subsequent READ key depressions will increment the memory address by one and display the contents of that address. Thus, 000 can be entered and with repeated depressions of the READ key, all of subscriber memory can be read.

**AUDIBLE TWO-TONE**

| DIGIT POSITION: | 1 2 3 | 4 | 5 | 6 7 | 8 9 |
|---|---|---|---|---|---|
| ENTER: | ADDRESS | 1 | * | TONE ONE | TONE TWO |

*0 = TONE ONLY
1 = TONE AND VOICE

**SUBAUDIBLE TWO-TONE**

| DIGIT POSITION: | 1 2 3 | 4 | 5 | 6 7 | 8 9 |
|---|---|---|---|---|---|
| ENTER: | ADDRESS | 2 | * | TONE ONE | TONE TWO |

*0 = TONE ONLY
2 = TONE OVER VOICE

**FIVE-TONE**

| DIGIT POSITION: | 1 2 3 | 4 | 5 6 7 8 9 |
|---|---|---|---|
| ENTER: | ADDRESS | 3 | FIVE TONES * |

(459 Hz IS AUTOMATICALLY SUBSTITUTED FOR THE SECOND CONSECUTIVE TONE OF THE SAME FREQUENCY.)

**SIX-TONE**

| DIGIT POSITION: | 1 2 3 | 4 | 5 6 7 8 9 |
|---|---|---|---|
| ENTER: | ADDRESS | 4 | FIVE TONES * |

(SAME AS FIVE-TONE EXCEPT A SIXTH TONE=2010 Hz IS AUTOMATICALLY SENT.)

*

| ENTER | FREQ (Hz) |
|---|---|
| 0 | 600 |
| 1 | 741 |
| 2 | 882 |
| 3 | 1023 |
| 4 | 1164 |
| 5 | 1305 |
| 6 | 1446 |
| 7 | 1587 |
| 8 | 1728 |
| 9 | 1869 |

(FOR PREAMBLE, SET OPTION 00=1.)

**UNIVERSAL GROUP CALL**

| DIGIT POSITION: | 1 2 3 | 4 | 5 6 | 7 8 9 |
|---|---|---|---|---|
| ENTER: | ADDRESS | 6 | * | START ADDRESS |

*NUMBER IN GROUP

**UNIVERSAL GROUP CALL WITH VOICE**

| DIGIT POSITION: | 1 2 3 | 4 | 5 6 | 7 8 9 |
|---|---|---|---|---|
| ENTER: | ADDRESS | 7 | * | START ADDRESS |

(THE LAST PAGE IN THE GROUP MUST BE A TONE-AND-VOICE PAGE.)

*NUMBER IN GROUP

Table 3-2. PROGRAMMING SUMMARY

AUDIBLE TWO-TONE FREQUENCIES

| DIGITS | FREQ. (Hz) | DIGITS | FREQ. (Hz) |
|---|---|---|---|
| 00 | 288.5 | 83 | 1251.4 |
| 01 | 296.5 | 84 | 1285.8 |
| 02 | 304.7 | 85 | 1321.2 |
| 03 | 313.0 | 86 | 1357.6 |
| 04 | 321.7 | 87 | 1395.0 |
| 05 | 330.5 | 88 | 1433.4 |
| 06 | 339.6 | 95 | N/D |
| 08 | 349.0 | 96 | N/D |
| 09 | 358.6 | 97 | N/D |
| 11 | 368.5 | 98 | N/D |
| 13 | 378.6 | 99 | N/D |
| 15 | 389.0 | | |
| 17 | 399.8 | N/D = Not Defined | |
| 18 | 410.8 | | |
| 20 | 422.1 | | |
| 22 | 433.7 | | |
| 24 | 445.7 | | |
| 26 | 457.9 | | |
| 27 | 470.5 | | |
| 29 | 483.5 | | |
| 31 | 496.8 | | |
| 33 | 510.5 | | |
| 34 | 524.6 | | |
| 36 | 539.0 | | |
| 38 | 553.9 | | |
| 40 | 569.1 | | |
| 42 | 584.8 | | |
| 43 | 600.9 | | |
| 45 | 617.4 | | |
| 47 | 634.5 | | |
| 49 | 651.9 | | |
| 51 | 669.9 | | |
| 52 | 688.3 | | |
| 54 | 707.3 | | |
| 56 | 726.8 | | |
| 58 | 746.8 | | |
| 59 | 767.4 | | |
| 60 | 788.5 | | |
| 62 | 810.2 | | |
| 64 | 832.5 | | |
| 66 | 855.5 | | |
| 67 | 879.0 | | |
| 69 | 903.2 | | |
| 71 | 928.1 | | |
| 73 | 953.7 | | |
| 74 | 979.9 | | |
| 75 | 1006.9 | | |
| 76 | 1034.7 | | |
| 77 | 1063.2 | | |
| 78 | 1092.4 | | |
| 79 | 1122.5 | | |
| 80 | 1153.4 | | |
| 81 | 1185.2 | | |
| 82 | 1217.8 | | |

ON DOUBLE NUMBER PAGERS IN 200 & 400 USE TONE 69 IN FIRST TONE

SUBAUDIBLE TWO-TONE FREQUENCIES

| DIGITS | FREQ. (Hz) |
|---|---|
| 00 | 67.0 |
| 01 | 71.9 |
| 02 | 77.0 |
| 03 | 82.5 |
| 04 | 69.3 |
| 05 | 74.4 |
| 06 | N/D |
| 07 | N/D |
| 08 | N/D |
| 09 | N/D |
| 10 | 85.4 |
| 11 | 88.5 |
| 12 | 91.5 |
| 13 | 94.8 |
| 14 | 79.7 |
| 15 | 100.0 |
| 16 | 103.5 |
| 17 | 107.2 |
| 18 | 110.9 |
| 19 | 114.8 |
| 20 | 118.8 |
| 21 | 123.0 |
| 22 | 127.3 |
| 23 | 131.8 |
| 24 | 136.5 |
| 25 | 141.3 |
| 26 | 146.2 |
| 27 | 151.4 |
| 28 | 156.7 |
| 29 | 162.2 |
| 30 | 167.9 |
| 31 | 173.8 |
| 32 | 179.9 |
| 33 | 186.2 |
| 34 | 192.8 |
| 35 | 202.7 |
| 36 | N/D |
| 37 | N/D |
| 38 | N/D |
| 39 | N/D |

N/D = Not Defined

GE 99 TWO-TONE FREQUENCIES

| DIGITS | FREQ. (Hz) |
|---|---|
| 07 | 682.5 |
| 10 | 592.5 |
| 12 | 757.5 |
| 14 | 802.5 |
| 16 | 847.5 |
| 19 | 892.5 |
| 21 | 937.5 |
| 23 | 547.5 |
| 25 | 727.5 |
| 28 | 637.5 |
| 30 | 652.5 |
| 32 | 607.5 |
| 35 | 787.5 |
| 37 | 832.5 |
| 39 | 877.5 |
| 41 | 922.5 |
| 44 | 967.5 |
| 46 | 517.5 |
| 48 | 562.5 |
| 50 | 697.5 |
| 53 | 667.5 |
| 55 | 712.5 |
| 57 | 772.5 |
| 61 | 817.5 |
| 63 | 862.5 |
| 65 | 907.5 |
| 68 | 952.5 |
| 70 | 532.5 |
| 72 | 577.5 |
| 89 | 622.5 |
| 90 | 742.5 |
| 91 | N/D |
| 92 | N/D |
| 93 | N/D |
| 94 | N/D |

N/D = Not Defined

To modify or program a new subscriber, the subscriber address must be entered followed by six more digits that uniquely define the type of subscriber. After entry is complete the subscriber code may be altered without re-entering the address.

The fourth digit entered is the encoding digit. This digit is defined as follows:

| | |
|---|---|
| 0*, 8, 9 | Invalid, entry will result in a Format error. |
| 1 | Audible Two-Tone |
| 2 | Subaudible Two-Tone |
| 3 | Five Tone |
| 4 | Six Tone |
| 6 | Universal Group Call (No Voice) |
| 7 | Universal Group Call (With Voice) |

0* is valid, only if all other digits are zero and results in an invalid subscriber.

NOTE

DO NOT place or leave a subscriber number all zeros within a group call sequence since doing so will result in the Minipage entering an undefined loop. If such an error occurs, turn the unit off momentarily (10 seconds) and reprogram the incorrect subscriber address.

Audible Two Tone

The keying sequence is:

| **Digit** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **Enter** |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Address** | | | **1** | **0/1** | **Tone 1** | | **Tone 2** | | |

Digit 5 is the format digit and determines the kind of two-tone page to be sent:

| Digit 5 | Meaning |
|---|---|
| 0 | Tone-Only |
| 1 | Tone-And-Voice |

If digits, 2 through 9 are entered in the fifth position, a Format error will occur after the ENTER key is depressed. The plastic Programming Card received with the terminal defines the audible two-tone frequencies. There are no invalid frequencies, with the exception of tones 95 and 99 which are undefined.

If a tone A group call is desired, Tone 1 only must be transmitted for eight seconds. To program a tone A group call, make Tone 2 equal to Tone 1. Tone 1 must be the desired group frequency.

Subaudible Two Tone

The keying sequence is:

| Digit | 1 2 3 | 4 | 5 | 6 7 | 8 9 | Enter |
|---|---|---|---|---|---|---|
| | Address | 2 | 0/2 | Tone 1 | Tone 2 | |

Digit 5 is the format digit and determines whether the subscriber is Tone-Only or Tone-Over-Voice:

| Digit 5 | Meaning |
|---|---|
| 0 | Tone-Only |
| 2 | Tone-Over-Voice |

A tone-only subaudible page will be sent only if the transmitter is not busy. A tone-over-voice subaudible page will be sent if the transmitter is not busy or during a voice interval if the transmitter is busy.

Digits 1 or 3 through 9 entered in the fifth position, will cause a Format error. Each tone number must be less than 40 or a Format error will occur. See option 70 for special conditions that occur when a subaudible two-tone page is initiated on a priority basis.

Five Tone

The keying sequence is:

| Digit | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| | Address | | | 3 Encoding | Tone Data | | | | |

The ten possible tones are:

| Freq. (Hz) | Enter |
|---|---|
| 600 | 0 |
| 741 | 1 |
| 882 | 2 |
| 1023 | 3 |
| 1164 | 4 |
| 1305 | 5 |
| 1446 | 6 |
| 1587 | 7 |
| 1728 | 8 |
| 1869 | 9 |

A frequency of 459 Hz is always transmitted in place of a tone identical in frequency to the preceding tone. For example, a pager tone code of 00112 specifies the following frequencies:

600 600 741 741 882

but they will be sent as:

600 459 741 459 882

In the case of more than two identical tones, the following substitution is made:

A pager tone code of 00001 would be:

600 600 600 600 741

but will be sent as:

600 459 600 459 741

The Minipage automatically makes the proper substitution. The operator need only enter the assigned numeric code of the pager and the alternative frequency of 459 Hz will be substituted as required.

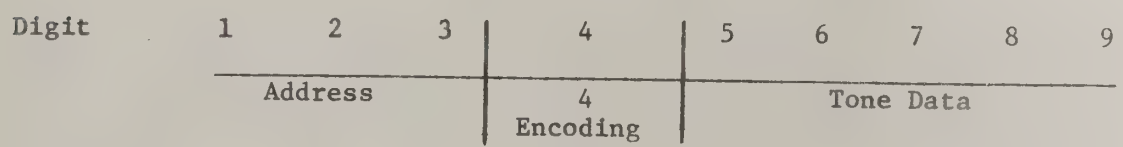
Since any combination of digits is valid in the Tone Data field, no format errors are possible.

If five-tone with preamble is required, feature 00 must be set to 01 when initializing the terminal. If the preamble feature is selected, all five/six tone pages will be sent with a 690 ms. preamble having a frequency equal to the first tone.

If five-tone with dual address pagers are used, Address 1 will be activated by the five tone code. (A six tone code is required to activate Address 2.)

Six Tone

The keying sequence is:




The tone data is identical to five-tone. All pages programmed as six tone will have a 2010 Hz sixth tone transmitted which activates Address 2 on dual address pagers. If the preamble option is specified, all 5 and 6 tone pages will be sent with a preamble having a frequency equal to the first tone.

Universal Group Call (No Voice)

The keying sequence is:

| Digit | 1 2 3 | 4 | 5 6 7 8 9 |
|---|---|---|---|
| | Address | 6 Encoding | # in Group Start Address |

A group of tone-only or tone-and-voice pagers may be sequentially signaled. The group must have contiguous addresses in memory and be within 100 number boundaries. Digits 5 and 6 define the size of the group; 63 is the maximum. Digits 7 through 9 define the starting memory location. Address locations not installed will result in a format error. For example, if the following is entered:

| Digit | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 0 | 0 | 6 | 1 | 0 | 0 | 1 | 0 |

Whenever the number 100 is received at a trunk interface, the terminal will attempt to sequentially send the pages programmed at addresses 10 through 19 beginning with 10.

UNIVERSAL GROUP CALL (WITH VOICE INTERVAL)

This option functions in the same way as does the universal group call (no voice) except that the last page in the group must be programmed for tone-and-voice operation. However, when this feature and the priority trunk (feature 70) are programmed to be active in the same terminal, the first and last pagers in the group must be programmed for tone-and-voice.

It should be noted that if the group call (with voice) and priority trunk options are programmed in the same Minipage Terminal, group call processing will be interrupted when a priority call is received by the terminal. Further, if the priority call received is programmed for tone-and-voice, all parties of the group call that were paged before the priority call was processed will hear the priority voice message. Also, if the priority pagee is equipped with a voice pager, he will, in effect, be added to the group call and will hear the group call voice message.

**The keying sequence is as follows:**

| 1 2 3 | 4 | 5 6 | 7 8 9 |
|---|---|---|---|
| Address | 7 Encoding | # in Group | Start Address |

A group call address sequence may not contain another group call.

Accounting Mode

This mode is operational only when the Call Counter option is installed, and the ACCOUNT keyswitch on the back of the console is in the horizontal position. (See figure 3-2.) To program this function, depress keys FUNC and 5. The Acct. Mode indicator will turn on. While in this mode, the call counters (one per subscriber) may be read or written. To switch from the Accounting mode to the Monitor mode, depress CANCEL.

Reading a Subscriber's Call Counter

When in the accounting mode, the call counter for any individual subscriber may be read by keying in the three digit address followed by READ. The value of the counter will be displayed in the right-most three positions. If READ is depressed again, the next higher address will be displayed on the left and the value of that counter on the right. This procedure may be repeated until all of the counters have been displayed.

### Modifying Individual Call Counters

Again, while in the Accounting mode, the call count of any individual subscriber may be modified. The rightmost (viewed from the rear) keyswitch must have the key inserted and be turned to horizontal. To modify a count, key in the desired three digit address followed by an appropriate three digit value. The address will be displayed at the left and the new value will be shown in the three rightmost digits. Depress ACCT ALTER followed by ENTER. The new value can be verified by depressing READ and visually checking the new value on the right side of the display.

### Initializing All Call Counters

Initializing all call counters to zero requires a different keying sequence than that used for other accounting mode functions. To enable this function, both keyswitches must be turned to horizontal. Key in FUNC and 7. The ACCT mode indicator will turn on. Enter 000 which will be displayed at the left. (There are no other valid entries.) Depress ACCT. ALTER twice (a dash will be displayed for each entry) followed by ENTER. All counters will clear and the display will go blank, the Acct. Mode indicator will turn off and the console will return to Monitor Mode.

## G. CONSOLE FUNCTIONAL OPERATION

### Monitor Mode

This is the "normal" mode of the console. With no activity, the power indicator is the only indicator on. The display will indicate transmitter activity each time the transmitter is keyed, while processing a page. The subscriber memory address will display in the rightmost three digits.

The terminal can be taken out of the Monitor mode by depressing any numeric key or by entering another mode via FUNC and the appropriate numeric key.

## Manual Mode

In this mode, pages may be entered from the console. The Manual Mode is entered from Monitor Mode by depressing any numeric key. The MAN. MODE indicator will turn on. In the Manual Mode any previously programmed subscriber can be signaled by keying in the three digit address followed by ENTER. Prior to depressing ENTER the sequence may be cleared by depressing CLEAR or CANCEL. After ENTER has been depressed all tone-only pages are sent and cannot be canceled. However, tone-with-voice calls may be canceled while in progress, by depressing CLEAR or CANCEL.

## Tone-Only Signaling

If the three digit address is a tone-only subscriber, the address will remain on the display until ENTER is keyed. If the transmitter is free, the address will be blanked on the left side and will reappear in the rightmost three digits. The TRANSMIT indicator will turn on. If the transmitter is busy and the tone only buffer is not full, the display will be blanked after ENTER and the console is ready to accept another manual entry.

If the tone-only buffer is full, all C's are displayed and the page cannot be sent.

## Tone-and-Voice Signaling

If the three digit address entered is a tone-and-voice subscriber the console voice option is required. If the voice option is not installed, the tone signaling will be sent as if the subscriber were tone-only.

If the transmitter is free, the Transmit indicator will turn on. As the page is processed, the pager address will appear on the right side of the display as it would for tone-only paging. The display will change to all dashes during the voice interval. All C's will appear when the voice interval completes. CANCEL or CLEAR must be entered to terminate the sequence.

If the transmitter is busy, the display will remain steady until the transmitter becomes free or the camp on interval expires. If the transmitter becomes free first, the call processes as described in the preceding paragraph. If the camp on interval expires, all C's will appear on the display and CANCEL or CLEAR must be entered to terminate the sequence.

H. TEST MODE

This mode is used to execute self-contained diagnostic tests and is entered by keying 'FUNC' and '3'. When Function Enable key-switch on the back of the console is in the horizontal position (see figure 3-2), the test mode indicator will turn on. The display will have 'C' shown in the leftmost position. At this time, three tests can be executed by entering digits 1, 2 or 3 followed by 'ENTER'.

Test 1 is a test of the Central Processing System and Console subsystem. The digit '8' will be displayed momentarily on each 7 segment display starting at the left. Note, the indicators will each turn on momentarily beginning with the manual indicator. When the test is completed, the test mode indicator will come back on and 'C' will be displayed on the left.

If while running the test, a call begins processing, the sequence in which the indicators light can be erratic depending upon the point in the test that the page processing begins. This, however, will not affect the overall test results.

Test 2 is a test of the tone generation system. Test 2 exercises the tone generation hardware by sending a tone and verifying that the tone has been detected by the self-contained reed relay. If this test fails, the display will indicate CUE-1 and the unit should be checked by a qualified service technician. A successful test will complete in approximately one second and return with 'C' displayed.

Test 3 is a test of the transmitter interface and Morse I.D. circuitry. Test 3 sends out the Morse code station identification. No further entries should be made until ID is complete. Note, that the transmitter alarm will not be activated for failures while in the test mode and the console TRANSMIT indicator will not light.

Alarm

A normally operated relay having a single pole, single throw open contact is wired to the rear terminal strip. The contact will close is one of the two following conditions occurs:

1. If the processor fails to function.

2. If any of the internal dc voltages drop as follows:

3. If the transmitter remains busy longer than the specified time (Feature 41), TX Alarm Enable (Feature 03) must be set to 01 for this to happen.

If the dc voltages drop below factory set reference levels, the internal circuitry will detect a failure and close the alarm contact.

Self Test Failure

If diagnostic test 2 fails signifying a tone generation failure, the alarm contact will close. In addition, CUE-1 message will be displayed on the console. If features 03 and 41 are active, the alarm contact will close if the transmitter is externally busy beyond the time defined by feature 41.

A CUE-1 message will be displayed if the subscriber memory test fails. This will most likely happen when the terminal is first unpacked and the power applied (power up). While the terminal will automatically correct the error, the display should be cleared by pressing the CLEAR key or by turning power off and back on.

# I. FUNCTIONAL DESCRIPTION OF CARDS

## CPU CARD (10008-1300)

### 1.0 INTRODUCTION

The M80 CPU is a basic microcomputer card designed to work with memory expansion and input/output cards in the HA-4000 Minipage. The basic M80 includes these features:

a. An 8080A processor and support logic.

b. Up to 2K bytes of program storage PROM.

c. 1024 bytes of data sotrage RAM.

d. An eight level priority interrupt system.

e. A programmable interval timer.

### 2.0 OPERATION

#### 1. Memory Allocation

The 8080A-1 has a 16 bit address bus and can address up to 64K words of memory. The M80 memory has been placed as shown in figure 3-3 Memory Mapping. RAM occupies the last 1K bytes ($FC\emptyset\emptyset_K$ to $FFFF_{16}$) of the address field. PROM occupies the first 2K bytes of the address field ($\emptyset\emptyset\emptyset\emptyset_{16}$ to $07FF_{16}$).

| DUAL TAPE | DTMF/DIAL | DTMF | COMBO W.W | COMBO | TONE GEN. | TRUNK INTFC. | MEMORY | M80-CPU | MINIPAGE BUS UTILIZATION | | | M80-CPU | MEMORY | TRUNK INTFC. | TONE GEN. | COMBO | COMBO W.W | DTMF | DTMF/DIAL | DUAL TAPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D | D | D | X | X | D | D | D | D | GND | 1 | 2 | +5 VOLTS | D | D | D | D | X | X | D | D |
| D | D | D | D | D | D | D | D | S | +AB0 | 3 | 4 | +DB0 | B | B | B | D | B | B | B | D |
| D | D | D | D | D | D | D | D | S | +AB1 | 5 | 6 | +DB1 | B | B | B | D | B | B | B | D |
| D | D | D | D | D | D | D | D | S | +AB2 | 7 | 8 | +DB2 | B | B | B | D | B | B | B | D |
| D | D | D | D | D | D | D | D | S | +AB3 | 9 | 10 | +DB3 | B | B | S | D | B | B | S | D |
| D | D | D | D | D | D | D | D | S | +AB4 | 11 | 12 | +PB4 | B | B | S | D | | | S | S |
| D | D | D | D | D | D | D | D | S | +AB5 | 13 | 14 | +DB5 | B | B | S | D | S | S | S | S |
| D | D | D | D | D | D | D | D | S | +AB6 | 15 | 16 | +DB6 | B | B | S | D | S | S | S | S |
| D | D | D | D | D | D | D | D | S | +AB7 | 17 | 18 | +DB7 | B | B | S | D | S | S | S | S |
| | | | D | D | | | D | S | +AB8 | 19 | 20 | -IH0 | D | | | | | | | |
| | | | D | D | | | D | S | +AB9 | 21 | 22 | -IR1 | D | | | | | S | S | |
| | | | D | D | | | D | S | +AB10 | 23 | 24 | -IR2 | D | | | | | | S | |
| | | | D | D | | | D | S | +AB11 | 25 | 26 | -IR3 | D | | S | | | | | |
| | | | D | D | | | D | S | +AB12 | 27 | 28 | -IR4 | D | | S | | | | | |
| | | | D | D | | | D | S | +AB13 | 29 | 30 | -IR5 | D | | S | | | | | |
| | | | D | D | | | D | S | +AB14 | 31 | 32 | -IR6 | D | x | x | x | S | S | | |
| | | | D | D | | | D | S | +AB15 | 33 | 34 | -IR7 | D | | | | | | | |
| | | | | | | | D | S | -MR | 35 | 36 | -I/OR | S | x | D | x | D | D | D | D |
| | | | D | D | | | D | S | -MW | 37 | 38 | -I/OW | S | D | D | D | D | D | D | D |
| | | | | D | | | B | S | -M5 | 39 | 40 | +Ø2 TTL | S | D | x | D | | | | |
| | | | | | | | | D | +RDYIN | 41 | 42 | +INT | D | | | | | | | |
| | | | | | | | | D | -HLD | 43 | 44 | -INTA | S | | | | | | | |
| | | | | | | | | S | +HHA | 45 | 46 | COR | x | x | x | x | S | S | | |
| | | | C | C | | | S | | -WRITE ENABLE | 47 | 48 | -CS ENABLE' | | S | | | C | C | | |
| x | D | D | S | S | | D | | | TIP1 | 49 | 50 | LINE 1 TELCO TX | | | D | | | | | S |
| | D | D | S | S | | D | | | RING 1 | 51 | 52 | LINE 1 TELCO RX | | | S | | | | | |
| | | | S | S | | | | | SLEEVE 1 | 53 | 54 | LINE 2 TELCO TX | | | D | | | | | S |
| | D | D | S | S | | D | | | TIP 2 | 55 | 56 | LINE 2 TELCO RX | | | S | | | | | |
| | D | D | S | S | | D | | | RING 2 | 57 | 58 | LINE 3 TELCO TX | | | D | | | | | S |
| | | | S | S | | | | | SLEEVE 2 | 59 | 60 | LINE 3 TELCO RX | | | S | | | | | |
| | D | D | S | S | | D | | | TIP 3 | 61 | 62 | BEEP TONE | | | D | S | D | D | | |
| | D | D | S | S | | D | | | RING 3 | 63 | 64 | DIAL TONE | | | D | S | D | D | | |
| | | | S | S | | D | | | SLEEVE 3 | 65 | 66 | RBT | | | D | S | D | D | | |
| | | | | S | | | | | RX CONSOLE | 67 | 68 | SMITTER AUDIO | | | S | S | D | B | x | x | S |
| C | | | S | S | | | | | CONN 1-1 (START 3) | 69 | 70 | CONN 2-1 (START 3) | | | | | S | S | | C |
| C | | | S | S | | | | | CONN 1-2 (MOTION 3) | 71 | 72 | CONN 2-2 (MOTION 3) | | | | | S | S | | C |
| C | | | S | S | | | | | CONN 1-3 (DOOR 3 PRESENT) | 73 | 74 | CONN 2-3 (DOOR 3 PRESENT) | | | | | S | S | | C |
| | | | S | S | | | | | CONN 1-4 | 75 | 76 | CONN 2-4 | | | | | S | S | | |
| | | | S | S | | | | | CONN 1-5 | 77 | 78 | CONN 2-5 | | | | | S | S | | |
| | | | S | S | | | | | CONN 1-6 | 79 | 80 | CONN 2-6 | | | | | S | S | | |
| | | | S | S | | | | | CONN 1-7 | 81 | 82 | CONN 2-7 | | | | | S | S | | |
| | | | S | S | | | | | CONN 1-8 | 83 | 84 | CONN 2-8 | | | | | S | S | | |
| | | | S | S | | | | | CONN 1-9 | 85 | 86 | CONN 2-9 | | | | | S | S | | |
| | | | S | S | | | | | CONN 1-10 | 87 | 88 | CONN 2-10 | | | | | S | S | | |
| x | x | x | S | S | x | x | x | x | CONN 1-11 | 89 | 90 | CONN 2-11 | x | x | x | x | S | S | x | x | x |
| | | | C | C | | | | | SPARE CONN 1-12 | 91 | 92 | CONN 2-12 SPARE | | | | | C | C | | |
| C | | | S | S | | | | | CONN 1-13 (TAPE 3 AUDIO) | 93 | 94 | CONN 2-13 (TAPE 3 AUDIO) | | | | | S | S | | C |
| D | D | D | D | D | D | x | x | D | D | +12 VOLTS | 95 | 96 | -12V | x | x | D | D | D | D | x | x | D |
| | | | D | D | x | D | | | -48V | 97 | 98 | +48V | | | D | | D | D | | |
| D | D | D | | | D | D | D | D | GND | 99 | 100 | +5 VOLTS | D | D | D | D | x | x | D | D | D |
| | | | | | | | | | | 101 | 102 | | | | | | | | | | |
| | | | | | | | | | | 103 | 104 | | | | | | | | | | |
| | | | | | | | | | | 105 | 106 | | | | | | | | | | |
| | | | | | | | | | | 107 | 108 | | | | | | | | | | |
| | | | | | | | | | | 109 | 110 | | | | | | | | | | |

LEGEND:

S = Signal Source
D = Signal Destination
B = Both Source and Destination
" " = Jumper Connected
C = Conflict (line is redefined on this board)

Table 3-3. MINIPAGE BUS UTILIZATION

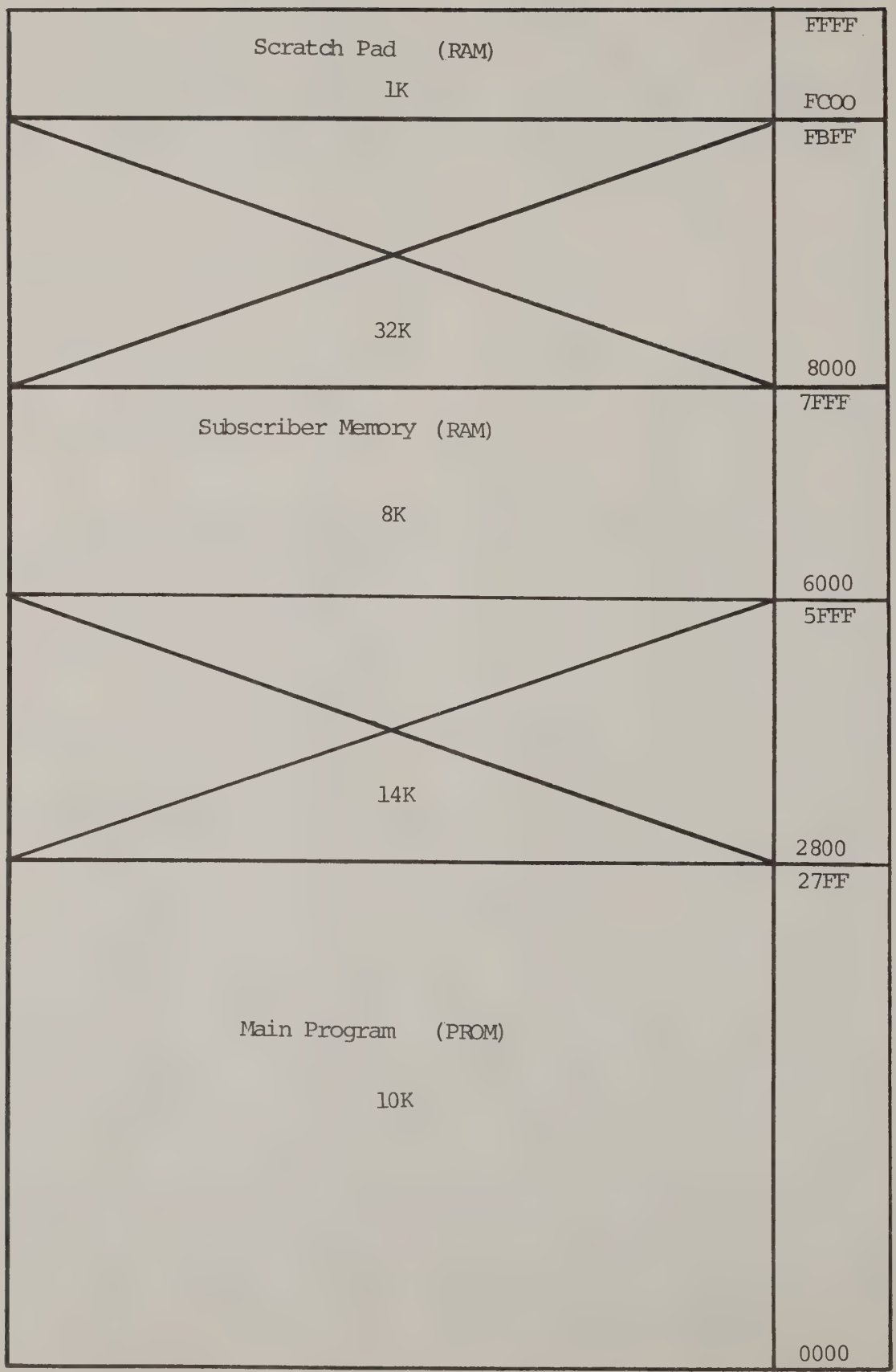



Figure 3-3. Memory Map

The RAM type used (350 msec 2102AL type) allows maximum CPU speed without using the memory ready feature.

## 2. Processor

The INTEL 8080A-1 is used on the M80. The standard 8080A-1 has a nominal 3.0 MHz clock. The M80 includes the support logic required to generate the 2 phase CPU clocks and the system control signals.

## 3. Priority Interrupt System

The M80 CPU includes an eight level priority interrupt system built around the RESTART instruction. This system allows a one byte call to an interrupt vector. The system consists of an eight level active low priority encoder and associated logic that is required to signal the 8080A that an interrupt request has been received.

The interrupt system is under software control. The system may be enabled or disabled using the 8080A internal interrupt enable flip/flop. The "current status register" is an output port ($FD_{16}$) that can be used to allow selective enabling of groups of interrupts (see 8214 specifications).

The interrupt request to the 8080A is reset with POR, and the internal 8080A enable flip/flop is disabled.

Table 3-4 shows the interrupt request priority and the restart vector addresses.

Table 3-5 shows the interrupt assignment for the Minipage.

Table 3-4. Priority Level Vectors

| | REQUEST | RESTART INSTRUCTION | VECTOR ADDRESS |
|---|---|---|---|
| (Highest) | IR 7 | RST 7 | ØØ7Ø |
| | IR 6 | RST 6 | ØØ6Ø |
| | IR 5 | RST 5 | ØØ5Ø |
| | IR 4 | RST 4 | ØØ4Ø |
| | IR 3 | RST 3 | ØØ3Ø |
| | IR 2 | RST 2 | ØØ2Ø |
| | IR 1 | RST 1 | ØØ1Ø |
| (Lowest)* | IR 0 | RST Ø | ØØØØ |

8

* POR causes the 8080A to start execution at ØØØØ. Use caution on this interrupt level.

Table 3-5. Interrupt Assignment

| | |
|---|---|
| IR 7 | Real time timer |
| IR 6 | Keyboard |
| IR 5 | TRUNK 1 |
| IR 4 | TRUNK 2 |
| IR 3 | TRUNK 3 |
| IR 2 | DIAL-OVER REC. |
| IR 1 | TT REC |
| IR 0 | POR/AUX |

4. Interval Timer

The M80 card contains a programmable interval timer with a time interval derived from the main CPU clock. CPU 2 clock is first divided by 256 and then used to clock the eight bit binary programmable count down counter. This counter may be loaded by software with any count from 1 to 255 and an interrupt request will be generated when the count reaches zero, the terminal count. The request will remain active until reset by the program.

Output port FF is used to write to the programmable counter and

reset the interrupt request flip/flop. Output port FE bit Ø is used to enable/disable the interrupt request latch from being presented to the priority interrupt system. At POR the interrupt request will be disabled but the interrupt request flip/flop will be set. The programmable timer should be loaded before the interrupt request is enabled. Note, that the programmable counter continues to count while the enable/disable flip/flop is disabled. An interrupt request may be pending when the interval timer is enabled, so it is advised that a count be sent to port FF prior to enabling the interval timer with port FE.

1 COUNT = 244.14063 HS
TIME = (# on DB +1) x 244.14063

## 5. Bus Signal Definitions

### 5.1 Address Bus

There are 16 address lines AØ-A15 used to address up to 64K words of program storage and data memory. AØ-A7 are also used to address up to 256 input/output ports. These lines are buffered with "Tri-State" buffers and will sink up to 12mA and source up to 2 mZ at the M80 Card edge at TTL levels. The buffers will enter the high impedance state with the HLDA (hold acknowledge) output of the 8080A. This mode is used in direct memory access (DMA).

### 5.2 Data Bus

There are eight bi-directorial Tri-State data lines DØ-D7. These lines are used to transfer data to and from memory and input/output ports. The DATA BUS buffer can sink 9 mA and source up to 1 mA at the M80 card edge. The DATA BUS buffers will enter the high impedance state during DMA.

## 5.3 Control Bus

-MR - A negative true signal indicating that a memory read (MR) operation is occurring and that the memory should drive the DATA BUS. -MR is a Tri-State signal that is capable of 9 mA sink and 1 mA source (to be called 1 standard drive, 1SD) DMA mode. See 8228 specs.

-MW - A negative true signal indicating that a memory write operation is occurring and that the present DATA BUS contents should be written into RAM. Often -MW can be used directly as the memory write pulse. 1SD, Tri-State, DMA mode. See 8228 specs.

-I/OW - A negative true signal indicating that an output addressed by A0-A7 port is being written to. The present DATA BUS contents should be written to the output with this pulse. 1SD, Tri-State, DMA mode. See 8228 specs.

-I/OR - A negative true signal indicating that an input port addressed by AG-A7 is being read into the processor. This line is used to gate the input to the DATA BUS. 1SD, DMA mode. See 8228 specs.

+12$T^2$L - A clock with TTL levels that is derived from the 12 CPU clock. 1SD. See 8224 specs.

+INT - A high level on this line is recognized by the 8080A as an INTERRUPT REQUEST (See 8080A specs). Line has a pullup to assure 8080A compatible levels. This signal is driven by the on board interrupt system and is only included for future expansion of the interrupt structure.

-INTA - A negative active signal indicating that an interrupt cycle is taking place and that the "interrupt instruction port" should be gated to the DATA BUS (see 8080A specs). 1SD. This line is included on the bus for future expansion of the interrupt structure.

-RS - A negative active Reset System pulse supplied for power on reset (POR). This signal should be used to reset the system to its initial state. 1SD. See 8224 specs.

+RDYIN - A positive level on this line indicates that the addressed memory is ready to supply data to the CPU. Slow memory may be synchronized to the CPU with this signal. (See 8080A specs, 8224 specs). Pullup resistor on input.

-HLD - A negative active signal that requests the CPU to enter the HOLD state. The HOLD state allows an external device to gain control of the 8080A address, data and control lines. (See 8080A, 8228 specs.)

+BHA - A Buffered Hold Acknowledge appears in response to the HOLD state and indicates that the data and address bus will go to the high impedance state (see 8080A specs). 1SD.

MEMORY CARD (10008-1400)

## 1.0 INTRODUCTION

The memory card provides 8K bytes of PROM memory (0800-27FF). All inputs and outputs are buffered on card.

## 2.0 OPERATION

Address inputs AB0-AB10 are buffered (p.2) and the buffered A0-A9 are routed to the PROM. Address bits AB11-AB14 are inputs to an address mapping PROM that selects the location of PROM. Mapping PROM bits 6 and 7 control selection of one block of 8 PROMs. Y/Z SELECT controls selection of the four Y PROMs or the four Z PROMs. Y/Z ENABLE enables selection of the Y/Z group when high. Selection within the Y or Z group is controlled by address bits A9 and A10. Mapping PROM bits 4 and 5 control selection of the W/X group of 8 PROMs in a similar manner. The RAM ENABLE Bit (bit 3) enables the chip select decode for the RAM memory (IC CZ). Address bits A10, AB11 and AB12 select one of 8 1K blocks. The lower 6 selects are used for minipage CMOS RAM and the upper 2 selects are used for standard RAM. Mapping PROM bit 1 is "anded" with the memory read signal and used to enable the MUX outputs to the data bus. This signal is used by the subscriber memory backpanel.

The memory card contains write-protect circuitry to protect CMOS memory from uncontrolled writes by the processor and writes when power is unstable. The processor must perform an OUT to port 7F immediately prior to writing to CMOS RAM. The out triggers one-shot T5 and enables a write to CMOS RAMs. R1, R2, CR1 and C1 form a +5.6 V supply for the CMOS RAM and its drivers. It is also used as a reference voltage for voltage dividers R3, R5 and R6. Output pin 13IC.W6 is high whenever the +5 V supply falls below 4.88 V. This enables one-whot T6 which fires on the next Ø2 unless a write is in progress. The Q output goes high and the

inverter formed by IC-W6 output pin 14 pulls the processor reset (RS) line low. The one shot firing also removes -CS ENABLE to the CMOS RAMs via IC-W6 output pin 1 and 2. These devices also compare the one-shot Q output to 4.02 V and remove -CS ENABLE when the output voltage falls below 4.02V. The net effect of the protection circuit is to reset the processor. Firing of the one shot is synchronized to Ø2 to insure that RAM chip selects are at least 500 ns long. The one shot is also held clear until completion of a write to prevent incorrect data from being written into memory.

The bipolar PROMs are power switched to minimize power dissipation.

Memory selection for the current mapping PROM is as follows:

| | |
|---|---|
| 0800-27FF | PROM |
| 6000-77FF | CMOS RAM (Mini-Page) |
| 7800-7FFF | Not Used |
| 8000-DFFF | Not Used |

Memory mapping PROM contents are shown in Table 3-6 on the following page.

| | Y/Z EN | Y/Z SE | W/X EN | W/X SE | RAM EN | DATA SE | DATA EN | SUB |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 7 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 8 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 9 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| A | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| B | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| C | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| D | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| E | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| F | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 10 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 11 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 12 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 13 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 14 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 15 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 16 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 17 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 18 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 19 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 1A | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 1B | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 1C | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 1D | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 1E | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 1F | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

Table 3-6. MEMORY MAPPING PROM CONTENTS

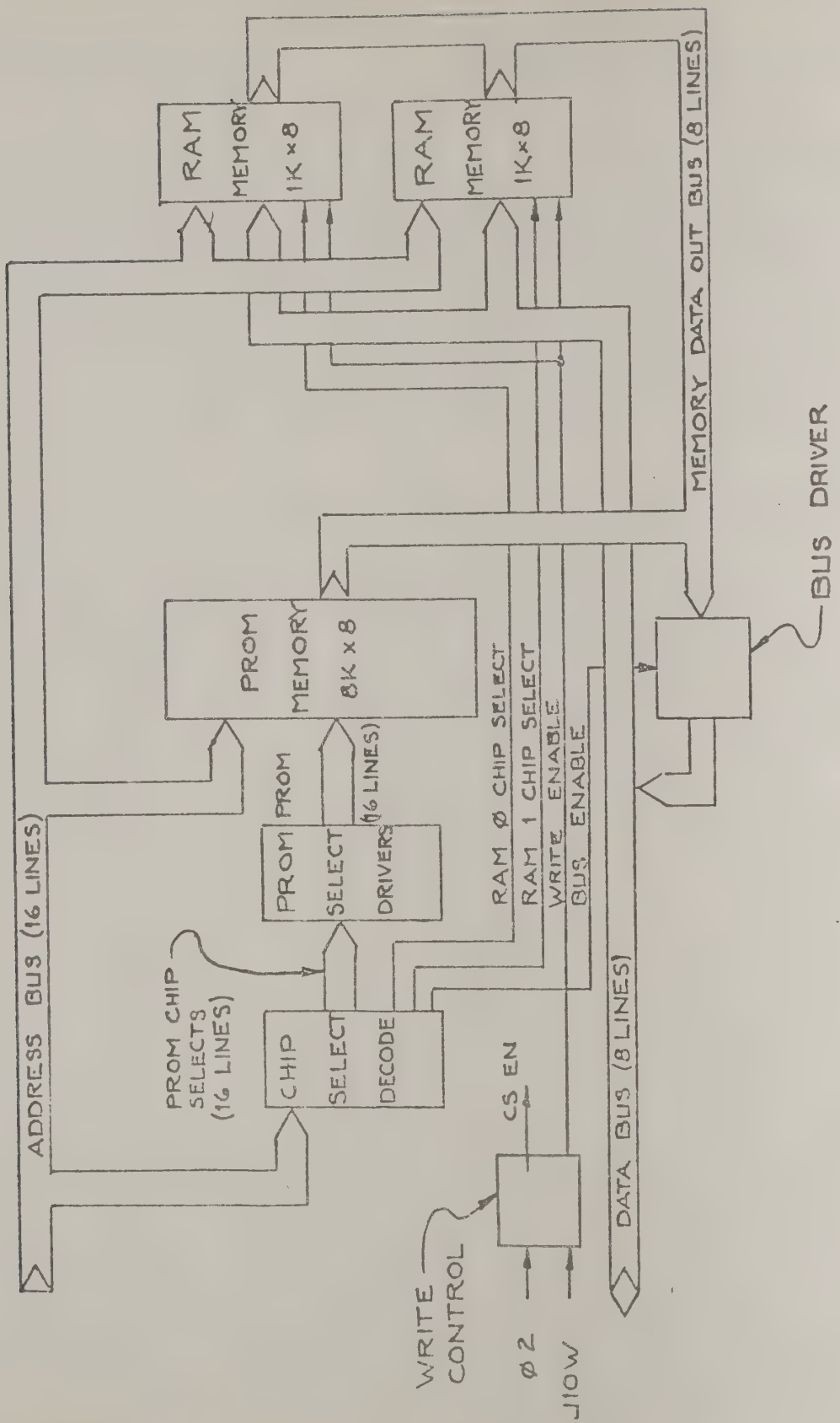



Figure 3-4. Memory Block Diagram

SUBSCRIBER MEMORY MODULE (10008-1600)

## 1.0 INTRODUCTION

This module is the non-volatile memory for storing pager codes and the options table. The unit consists of four 1K x 1 CMOS RAM to provide a 1K x 4 memory. The battery back-up provides enough current for the chips to retain data for 20 days without external power. The Nicad batteries are trickle charged through a 330 ohm resistor. They are rated for 100 MAH at about 25$^{o}$C.

## 2.0 OPERATION

The 1K x 4 memory has separate Data-In and Data-Out lines and two control signals: $\overline{WE}$ and $\overline{CS}$. The terminal options configuration table occupies the end of the first subscriber RAM from 6384 to 63FF.

COMBO CARD (10008-1120)

## 1.0 INTRODUCTION

This card provides circuitry required for functions not performed on any other card.

## 2.0 OPERATION

### 1. I/O Diode

This circuit contains the decode for the I/O Ports and for the console Memory chip select.

| OUT PORTS | SIGNAL |
|---|---|
| $47_H$ | -Alarm Holdoff |
| $46_H$ | -Console Mike Off |
| $45_H$ | -Console Mike On |
| $44_H$ | -Update Console Tone Reg. |
| $48_H$ | -Transmitter Key |
| $49_H$ | -Transmitter Unkey |

| INPORTS | SIGNAL |
|---|---|
| $49_H$ | -Read Status |
| $48_H$ | -Read Keyboard |
| $4A_H$ | -Spare |
| $4B_H$ | -Spare |

### 2. Alarm and Voltage Detect

This circuit provides for detection of faulty voltage by using an opto-isolator to test the 48 volt loop and a summing node with compartors to test the +5 and ±12 voltages. If any voltage fails, a logic low signal is sent to the alarm circuit. This forces the retriggerable one-shot to clear, thus de-energizing the alarm relay and closing the alarm contact. In normal operation the one-shot is retriggered by the processor every 50 ms. If the retriggering

stops for more than 75-100 ms, the alarm will activate. The front panel alarm LED indicates occurrence of a failure.

3. Keyboard Decode

This circuit receives a hexidecimal digit via 12 volt signals from the console keyboard. These signals and a strobe are converted to TTL level signals and then latched in a tri-state device. The strobe creates an interrupt. When the "Read Keyboard" is received, the interrupt is reset and the Hex data is gated onto the lower 4 bits of the data bus.

4. Display Memory and Decode

This circuit consists of a memory for the displayed digits, and address decode for the memory, and a scanning circuit for multiplying the digits to the display. The memory is 16 x 4 bits and is overlaying the lower 16 Bytes of program RAM ($FC00_H$). The 1400 Hz Beep Tone is used as the scan clock. A reset is generated at the end of each complete display time to insure the timing is always correct.

5. Console Audio

The audio is transmitted to and from the console via differential lines. Relays control the direction of flow. CMOS gates are used as switches for sending the audio to the transmitter. There is also a selector and gates to send signal tones to the console.

| | |
|---|---|
| DB2 | RBT |
| DB1 | Beep Tone |
| DB0 | Dial Tone |

This selector is controlled by the "Update Console Tone Register" signal. The other signal going to the console is the "console audio control" which determines when the microphone should be enabled.

## 6. Transmitter Interface

The transmitter interface has two stages. The first provides buffer and driver with gain control. The record stage is an audio isolation transformer for interfacing to the transmitter. Also included in the circuit is a reed relay for diagnostic feedback.

The keying relay has four loops, one of which is used internally to determine when the transmitter is keyed (drives indicator LED and keying feedback signal).

There are status back to the processor on port. (Read status)

| | |
|---|---|
| DB7 | -TX BUSY (externally Busy) |
| DB6 | -Keying Diagnostic Feedback (KEYING) |
| DB5 | +Diagnostic Feedback Tone |

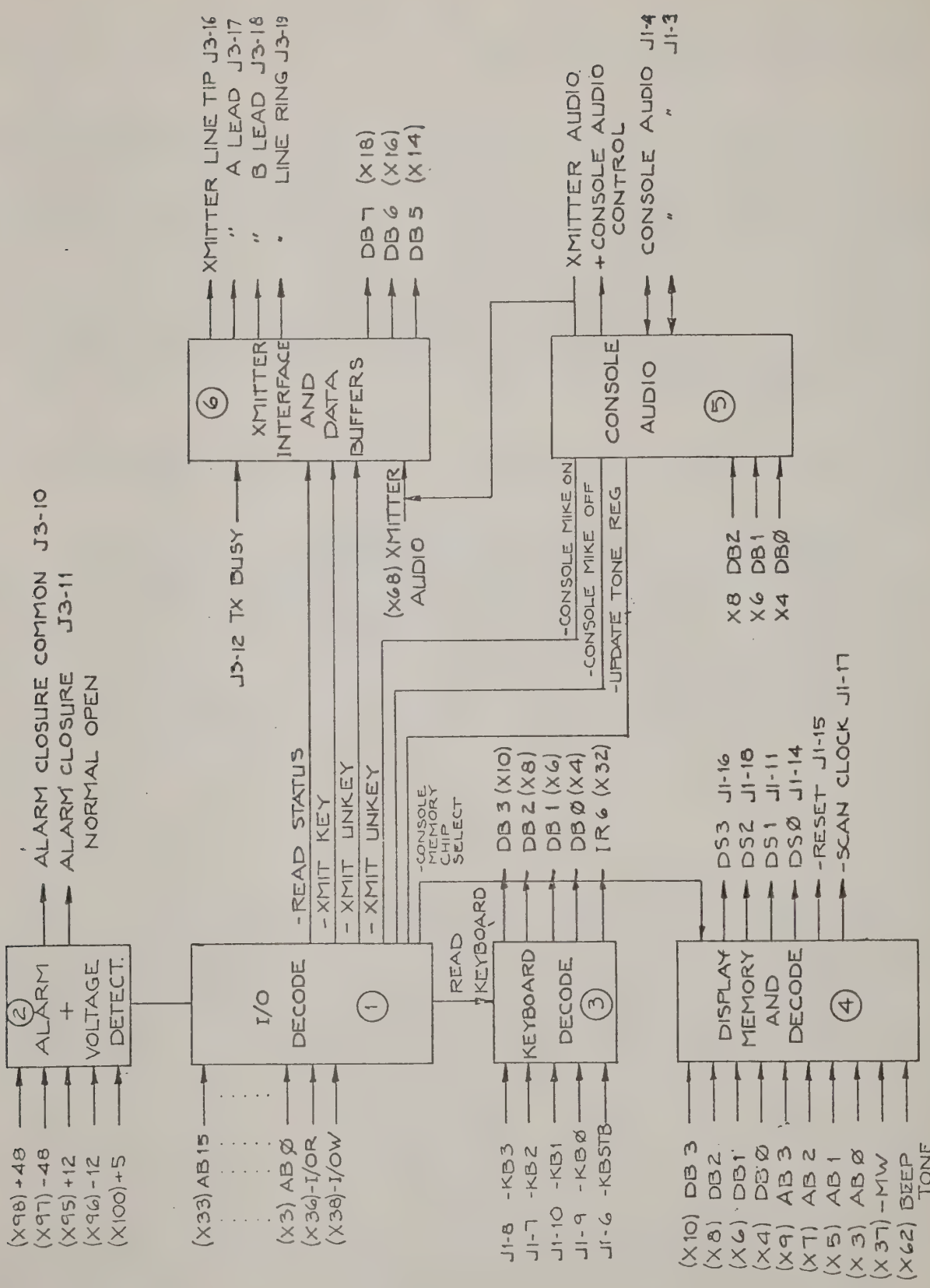



Figure 3-5. Combo Card Block Diagram

TRUNK CARD (10008-1700)

## 1.0 INTRODUCTION

The basic function of this card is to interface a telco line (selector level or end-to-end) to the minipage. This card is the same for all trunks and both modes of operation except for two jumper plugs. The first determines which trunk line (1, 2, or 3) and the second determines which mode (selector level or end-to-end). The selector level operation will be described first and then the differences for end-to-end operation.

## 2.0 OPERATION

### 1. I/O Decode

| Output Ports | | | Signal | |
|---|---|---|---|---|
| Trk 1 | Trk 2 | Trk 3 | | |
| $66_H$ | $6E_H$ | $76_H$ | Transmitter voice OFF | Gates Voice path to transmitter |
| $65_H$ | $6D_H$ | $75_H$ | Transmitter voice ON | |
| $60_H$ | $68_H$ | $70_H$ | +Seizure | Performs reverse battery function |
| $61_H$ | $69_H$ | $71_H$ | -Seizure | |
| $63_H$ | $6B_H$ | $73_H$ | Dial Pulse counter Reset | |
| $62_H$ | $6A_H$ | $72_H$ | Trunk interrupt Reset | |
| $64_H$ | $6C_H$ | $74_H$ | Tone update - provides data decode for control signals back to Telco | |

| Input Ports | | | Signal | |
|---|---|---|---|---|
| Trk 1 | Trk 2 | Trk 3 | | |
| $60_H$ | $68_H$ | $70_H$ | Trunk Status | |
| | | | DB7 | -Trunk Present |
| | | | DB6 | -Break (loop Current) |
| | | | DB5 | +End-to-End Trunk |
| | | | DB4 | -Ringing |
| Described under data buffers | | | DB3 | BCD Digit from dial Pulse Counter |
| | | | DB2 | |
| | | | DB1 | |
| | | | DB0 | |

2. Switch Control

When a "Tone Update" signal is received, the lower three bits of the data bus are used to determine which signal tone is returned to the Telco.

| | | | |
|---|---|---|---|
| DB2 | High True | turns on | Ring back |
| DB1 | High True | turns on | Beep Tone |
| DB0 | High True | turns on | Dial Tone |

These tones remain until reset.

3. Audio Patch Switches

Consist of the switches for gating the signal tones to the Telco as stated under switch control block. Also available as an input to the amplifier is an audio line off the back plane which would contain audio from the message recorders. The circuit is completed with an adjustable amplifier which controls audio back to the Telco.

4. Dial Pulse Counters and Data Buffers

Dial pulse counter is incremented each time there is a break in the loop current. It is used to decode the last 2 or 3 digits of a selector level line. It is reset by command from the processor. The data buffers are tri-state bus drivers. Their associated value is:

| | |
|---|---|
| DB7 | -Trunk Present |
| DB6 | -Break (loop Current) |
| DB5 | +End-to-End Trunk |
| DB4 | -Ringing |
| DB3 | |
| DB2 | BCD Digit from dial pulse counter |
| DB1 | |
| DB0 | |

5. AGC Amp and Switch

The AGC AMP receives audio from transformer T-1 for transfer to the switch G-3 to the transmitter. R-37 is the AGC input control and R-38 is the transmitted voice control.

6. Interrupt is created when loop current is broken. Break is used to create this interrupt but goes through a retriggerable one shot so that only one interrupt is created when a digit is dialed in and when the calling party hangs up. Interrupt assignment is accomplished through the Trunk line selector jumper, A-4, A-5 and A-6.

| | | | |
|---|---|---|---|
| A-6 for | IR5 (x30) | Trunk 1 | interrupt |
| A-5 for | IR4 (x20) | Trunk 2 | interrupt |
| A-4 for | IR3 (x26) | Trunk 3 | interrupt |

For end-to-end Trunks "Ringing" is used through a retriggerable one shot to create the interrupt. Break is not used.

7. Telco Interface

With mode jumper in F5 position, the trunk is set as a selector level trunk. The loop formed from tip to ring goes through the input transformer, current detect, IC-4 and the 48 V power supply. The current detect circuit is an opto-isolator used for generation of "-Break" signal.

Upon receiving a valid subscriber number, a seizure signal initiates relay K-1 which reverses the polarity of the battery (48 volts). The battery reversal is used by the Telco for billing and line supervision.

End-to-End Operation

The mode jumper should be in location F5. Whenever ringing occurs, it will be detected by an opto-isolator D5 to create the -ringing signal. This signal is not used with selector level trunks. The board is capable of being modified to receive either tip to ground or bridge ringing by cutting and jumpering X, Y, and Z. The standard is bridge ringing.

After ringing is detected, seizure occurs. This action puts the transformer in the same pattern as after seizure for selector level lines (see Section 3B).

8. Bell-Canada Option

This circuit is used to send a 1400 Hz burst of tone back to the Telco immediately after battery reversal (seizure) has occurred.

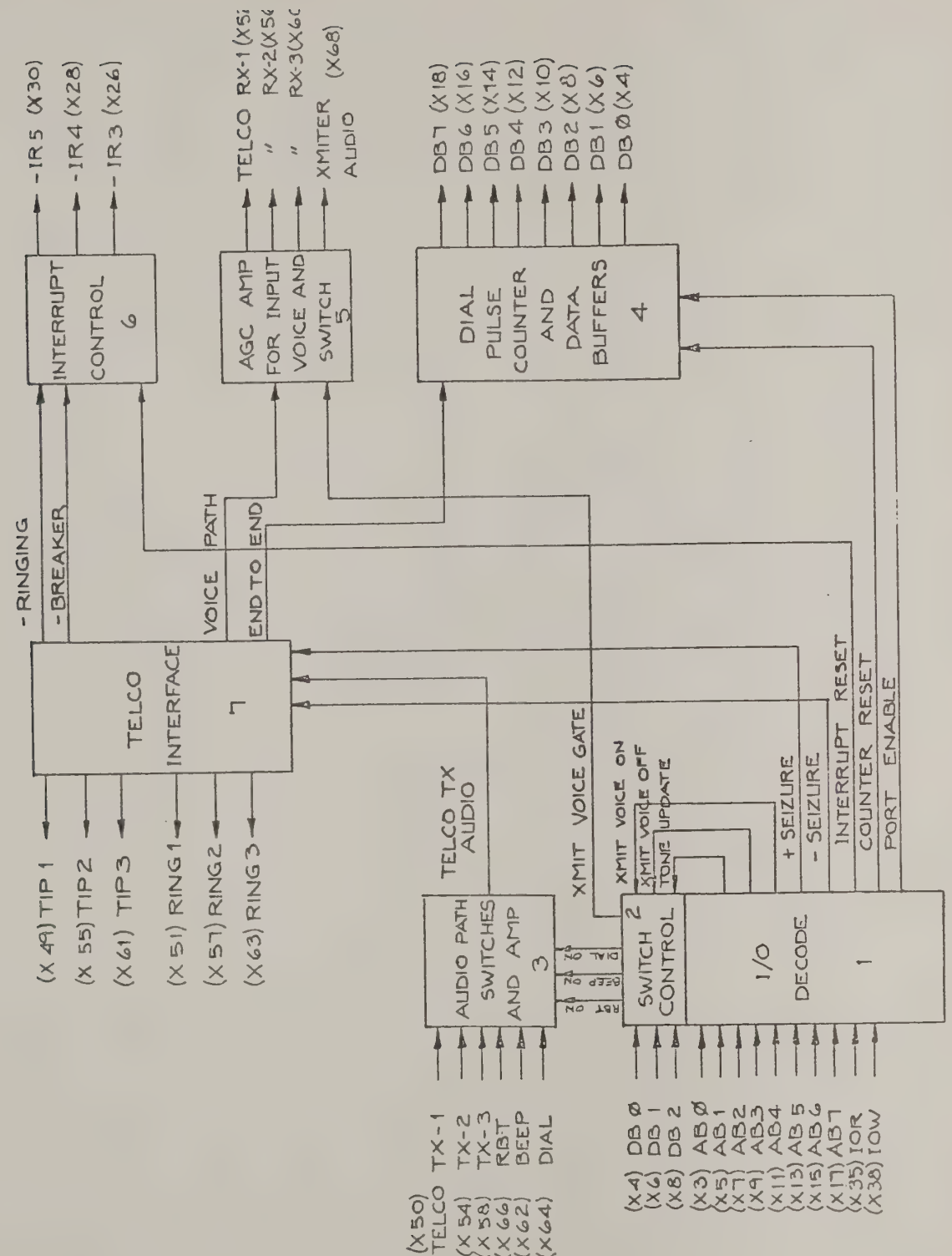



Figure 3-6. Trunk Card Block Diagram

TONE GENERATOR CARD (10008-1500)

## 1.0 INTRODUCTION

This card provides the signal tones for the telco (Dial Tone, Ringback, and Beep Tone) and the tones necessary for Paging. There are three basic clocks:

## 2.0 OPERATION

### 1. I/O Control

This circuit decodes the addresses to produce signals to load tone data in the registers and to turn the tone generator on and off.

a. Port assignment

| | |
|---|---|
| 42 H | Turns Tone generator on |
| 43 H | Turns Tone generator off |
| 40 H | Loads upper 8 Bit register |
| 41 H | Loads lower 8 Bit register |

b. 104.8576 kHz

Derived by dividing Ø2TTL by 16 to get the desired shift rate for the phasing generator.

### 2. Signal tone generator

Oscillators are used to produce four frequencies.

a. 620 Hz. Combined with 480 Hz to produce dial tone.

b. 480 Hz. Used as above and combined with 440 to produce ring back.

c. 440 Hz. Used as above.

d. 1400 Hz. Used as beep tone.

These tones are available on the back plane at all times.

3. Paging Tones Generator

Sixteen bits of data are loaded into the tone generator, eight bits at a time by using load upper and load lower register commands.

The memory chips, ICs A1, A2, A3, and A4 are used to provide 16 bits of frequency data. The 16 bits are the binary equivalent of the desired frequency times ten. This allows a frequency resolution of 0.1 Hz. This binary number is fed to the tone generator. The first section of the tone generator is a phase register(ICs C1, C2, C3, and C4) and incrementer (ICs B1, B2, B3, and B4). The phase register holds the binary representation of the phase angle of a sine wave with all 0s equal to 0 degrees and all 1's equal to 360 degrees. A steady 104.8576 kHz is constantly adding a phase increment from the memories into the register, thus, the magnitude of the increment will determine the frequency. The upper seven bits of the phase register go to a converter which first converts the phase to a binary representation of the amplitude of a sine wave at the phase angle, and then into an analog voltage. The binary phase to binary amplitude conversion is done in a IM5610 PROM (ICE5). The PROM contains a table for one quadrant of the upper seven bits. The other quadrants are obtained by using the six and seven bits to control symmetry reflections of the first quadrant. Bit six inverts the lower five bits by means of Exclusive OR gates in ICs D4 and D5, thus, causing the address count going into the PROM to reverse the polarity of the analog signal at 180 and 360 degrees. The eight bit amplitude data from the PROM feeds a MC1408 digital to analog converter (IC-F6). The output of op-amp IC D6 is used as a current to voltage converter. The other half is used as a plus or minus unity gain stage controlled through an

analog switch (one section of IC D6) by bit 7 as mentioned above. The one percent resistors are required to ensure that the plus and minus gain are equal, otherwise distortion will occur. The output of IC D6 is a stepped approximation of a sine wave.

Because the frequency range of interest extends only to 4000 Hz and because the stepped output is undesirable, the signal is passed through two stages of two pole Butterworth filters (IC B6). Both stages are set to roll off at 4000 Hz using five percent components for frequency accuracy. The overall roll-off of 12 dB per octave above 4000 Hz effectively removes the harmonics resulting from the stepped approximation. The output is typically 1 volt P-P with less than one percent distortion. Frequency accuracy is controlled by the 104.8576 kHz input.

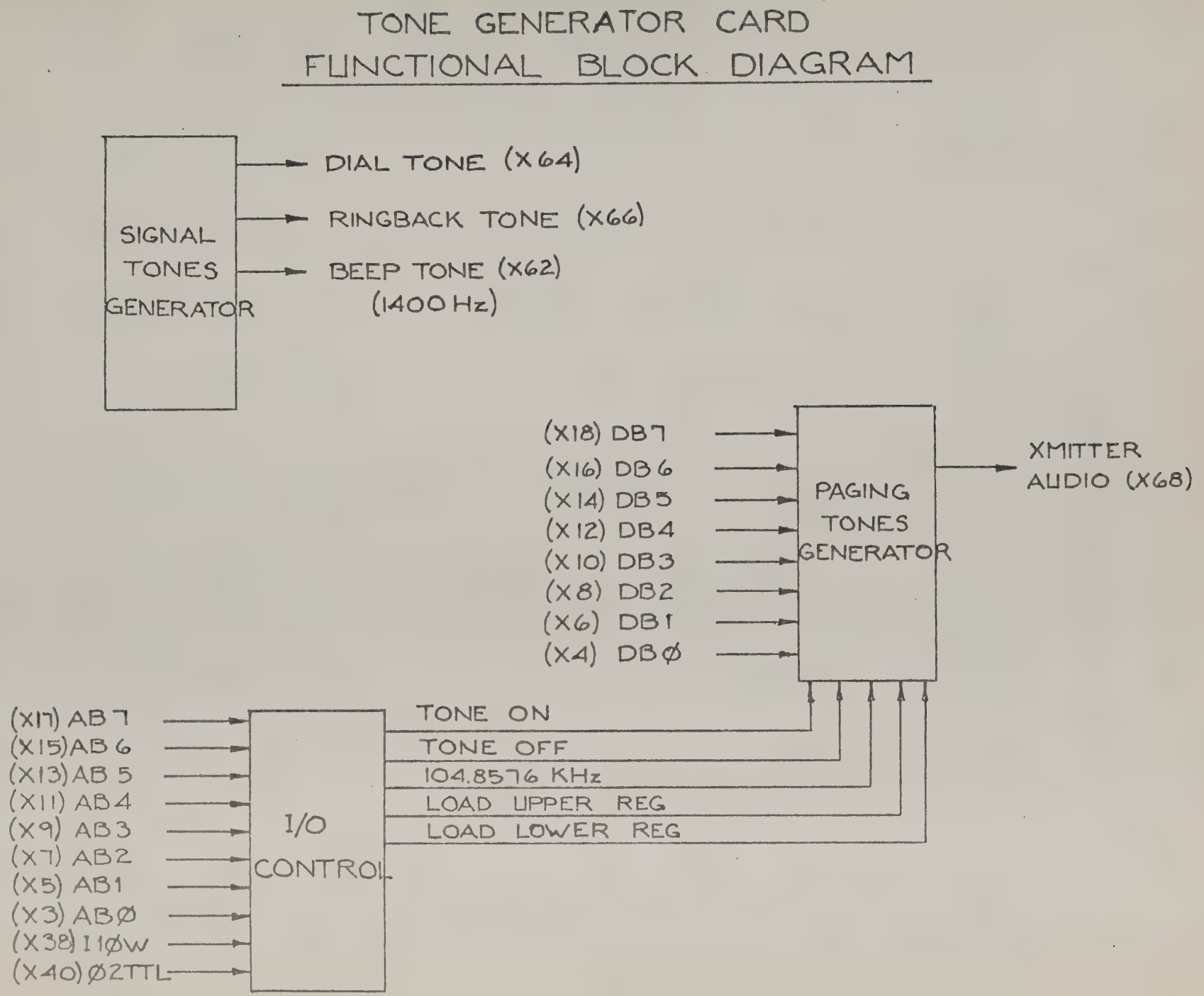



Figure 3-7. Tone Generator Block Diagram

## SINE TABLE ROM

| ADDRESS | | | | | DATA | | | | | | | | HEX | HEX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $A_4$ | $A_3$ | $A_2$ | $A_1$ | $A_0$ | $D_7$ | $D_6$ | $D_5$ | $D_4$ | $D_3$ | $D_2$ | $D_1$ | $D_0$ | ADDRESS | DATA |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 00 | Ø6 |
| 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 01 | 13 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 02 | 1F |
| 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 03 | 2C |
| 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 04 | 35 |
| 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 05 | 44 |
| 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 06 | 5Ø |
| 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 07 | 5C |
| 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 08 | 67 |
| 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 09 | 73 |
| 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0A | 75 |
| 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0B | 89 |
| 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0C | 93 |
| 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0D | 5D |
| 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0E | A7 |
| 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0F | BØ |
| 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 10 | B9 |
| 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 11 | C2 |
| 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 12 | CA |
| 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 13 | D1 |
| 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 14 | DØ |
| 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 15 | DE |
| 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 16 | E4 |
| 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 17 | EA |
| 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 18 | EF |
| 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 19 | F2 |
| 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1A | F6 |
| 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1B | FA |
| 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1C | FC |
| 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1D | FE |
| 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1E | FF |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1F | FF |

TABLE 3-7. SINE TABLE ROM

CONSOLE PC CARD (10008-2050)

## 1.0 INTRODUCTION

The two major sections of this board are the keyboard circuitry and the display circuitry. Signals are also provided for console audio which has not been designed.

## 2.0 OPERATION

### 1. Keyboard

The keyboard consists of 16 keys, "ACCT ALTER" and "FUNCTION" are each series connected with a key-lock switch which can disable the two functions. The 16 keys go to two 8-to-3 line encoders. Each encoder provides a strobe signal whenever an input goes low. These two strobe lines are "ORed" to provide the -KSTB signal which is used on the Combo board to create the keyboard interrupt (Interrupt 6). The outputs of the encoders are gated such that a 4 bit hexadecimal number is produced which corresponds to -KB3, -KB2, -KB1, -KB0. The codes are given in Table 3-8 on the following page.

### 2. Display

A PROM is used to decode a Hex value into a seven segment display pattern. These seven signals turn on transistors to provide the drive for each segment. The clock signal increments a counter which is decoded to provide the signals necessary for the drive transistors for each device. There are nine digit displays and a set of seven indicator LEDS which act as one digit. Therefore, there are ten divices to be multiplexed. At the end of the tenth device the reset signal resets the counter to the first device.

Two LED GROUND lines are provided because of the current sinking requirements of the displays.

Table 3-8. Codes for Display PROM and Keyboard

| Hex Value | Digit Displays | Indicator Displays | Keyboard Encoding |
|---|---|---|---|
| Ø | 0 | Manual Mode | 0 |
| 1 | 1 | Subscriber Mode | 1 |
| 2 | 2 | Accounting Mode | 2 |
| 3 | 3 | Options Mode | 3 |
| 4 | 4 | Monitor Mode (All Blank) | 4 |
| 5 | 5 | Test Mode | 5 |
| 6 | 6 | Monitor + Transmit Mode | 6 |
| 7 | 7 | Monitor + Auxiliary Mode* | 7 |
| 8 | 8 | Manual + Transmit Mode | 8 |
| 9 | 9 | Subscriber + Transmit Mode | 9 |
| A | E | Accounting + Transmit Mode | CANCEL |
| B | U | Options + Transmit Mode | CLEAR |
| C | C | Manual + Auxiliary Mode | READ |
| D | F | Subscriber + Auxiliary Mode | ENTER |
| E | - | Accounting + Auxiliary Mode | FUNCTION |
| F | Blank | Options + Auxiliary Mode | ACCOUNTS ALTER |

| | |
|---|---|
| Power On | 0 |
| Manual Mode | 0 |
| Subscriber Mode | 0 |
| Accounting Mode | 0 |
| Options Mode | 0 |
| Test Mode | 0 |
| Auxiliary | 0 |
| Transmit | 0 |

Console Panel Indicator Display Placement

*Auxillary mode is not used

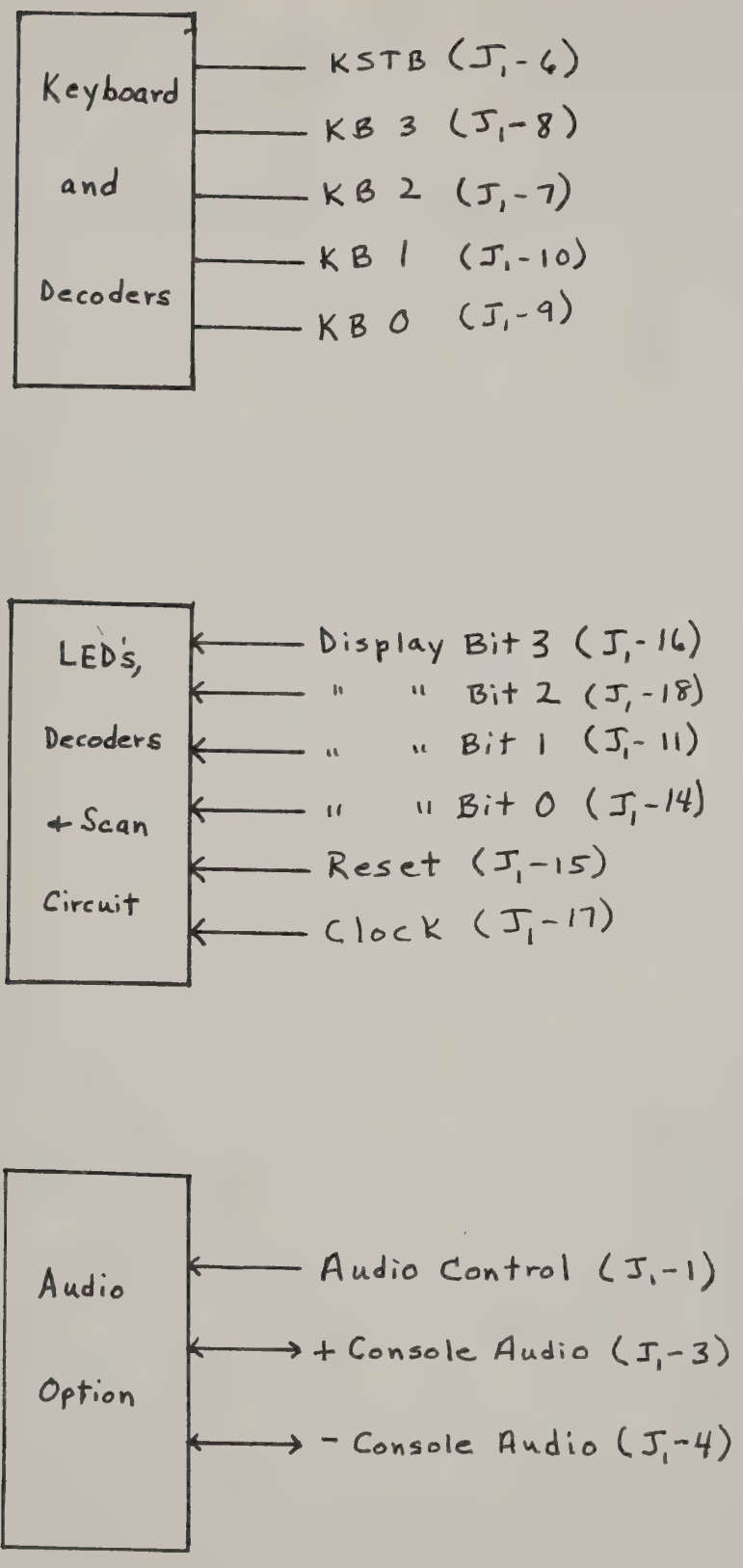



Figure 3-8. Console Card Block Diagram

DUAL TAPE DECK INTERFACE (10008-0210)

## 1.0 INTRODUCTION

There are four signals required to control and receive data from the tape deck.

1. Audio path from the deck.

2. Motor on signal from the deck. This signal is a Low True pulse which is on whenever the tape deck motor is running. This signal is OR'ed with the motor start pulse to insure continuity of the signal level.

3. Motor start signal to the tape deck. This High True pulse is used to start the motor.

4. Deck Present signal (Low True). This signal is a level which occurs whenever the cable is connected to the tape deck. This signal is used to determine when the deck is present.

## 2.0 OPERATION

1. The processor determines which deck is needed and to which device the deck must be interfaced (Trunk 1, 2, 3, or transmitter). Signals are sent to start the motor and to select the proper interface. These control signals are decoded by the switch control and I/O Port control to initiate the one shot for a motor start and to gate the audio to the proper device. More than one device may receive the same audio message. The "Deck present" and the "motor on" signal are gated onto the data bus to be read when necessary. When the motor on signal goes high the processor opens the audio path. The tape deck has an automatic stop at the end of each message.

2. I/O Port Designations

Output Ports

| | |
|---|---|
| $78_H$ | latches gate control for audio for Tape 1 |
| $79_H$ | starts Tape 1 |
| $7A_H$ | latches gate control for audio for Tape 2 |
| $7B_H$ | starts Tape 2 |

Input Ports

| | |
|---|---|
| $78_H$ | Tape 1 status |
| $7A_H$ | Tape 2 status |

DATA BITS for output ports $78_H$ and $7A_H$

| | |
|---|---|
| DBØ | High gates audio to Trunk 1 |
| DB1 | High gates audio to Trunk 2 |
| DB2 | High gates audio to Trunk 3 |
| DB3 | High gates audio to Transmitter |

DATA BITS for input ports $78_H$ and $7A_H$

| | |
|---|---|
| DB7 | low says deck is present |
| DB6 | low says motor is on |

3. Functional Blocks

Audio Amps and Switches

This circuit controls the gain for the audio from the tape deck which then goes through the proper CMOS gate to the proper device.

Motor Control

This circuit consists of one shots and drivers to start the motors (need 12 volt signals).

Data Bus Driver

This circuit gates motor on-start morot signals and the deck present signal to the data bus.

Switch control and I/O Port Control

This circuit decodes the Data lists and address bits (with I/O control signals) to determine which device receives the audio, when a motor start command was issued, and when to put data on the data bus.

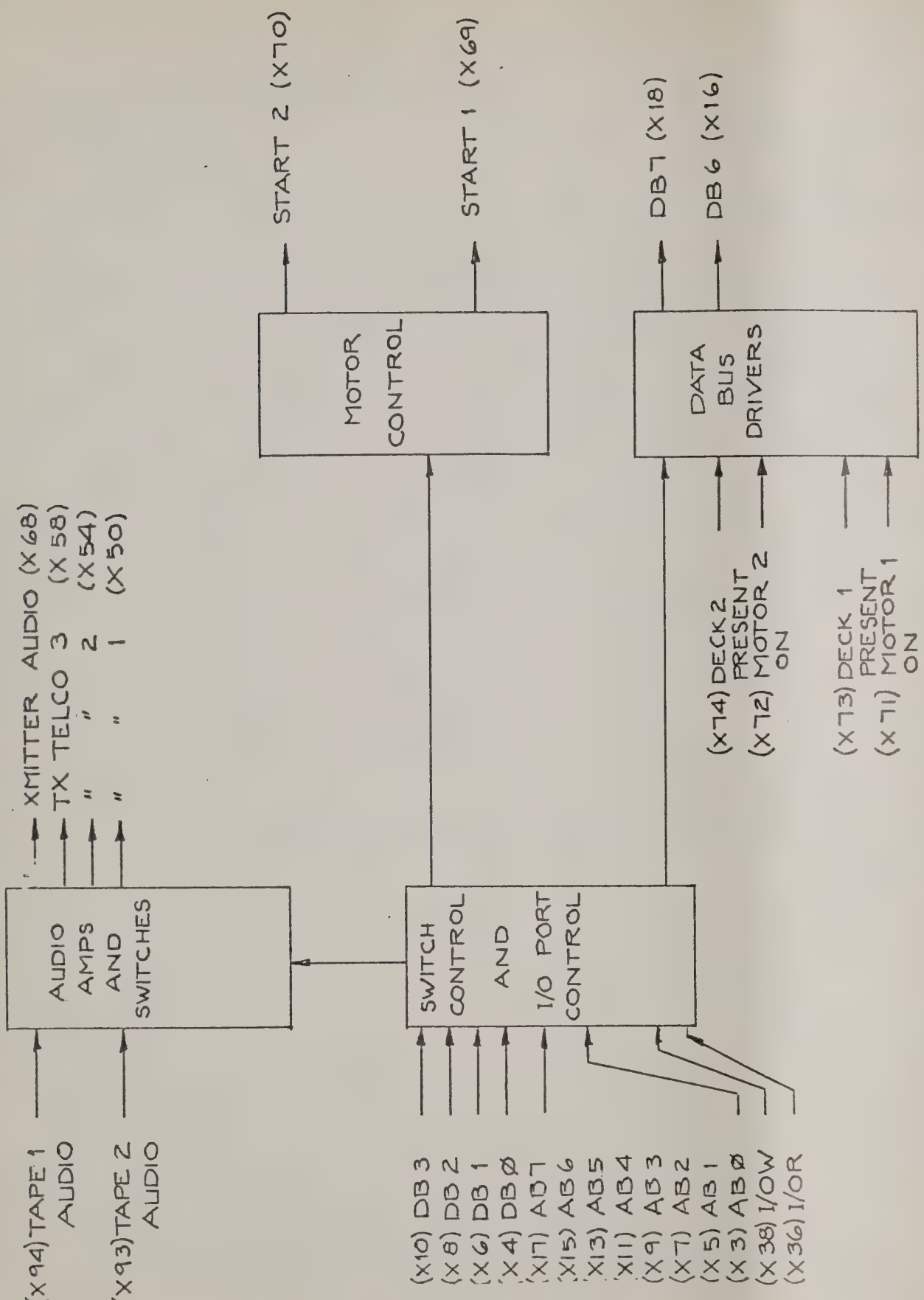



Figure 3-9. Dual Tape Deck Block Diagram

TOUCH TONE RECEIVER CARD (10008-0100)

## 1.0 INTRODUCTION

This card takes DTMF tones from the phone lines and converts the tones to a row and column value for decoding to Hex or BCD. One card serves three trunk interfaces. The trunk to be serviced is selected by output port $3F_H$ and data bits DB0, DB1, and DB2 which correspond to Trunk 1, Trunk 2, and Trunk 3. Once the Trunk is interfaced there is an audio path from the Telco to a MITEL CM 8825 Touchtone decode module. The outputs of the module include a high BCD tone, a low BCD tone, and a storbe. The strobe is used to create an interrupt (IR1) to the processor. The high and low BCD tones correspond to Row and Column selections for the processor. The high and low BCD tones correspond to Row and Column selections for the processor. These tones are latched in tri-state latches and are read thorugh input port $3F_H$. DB7-DB4 define the high and DB3-DB0 define the low BCD tones. Only one bit in each field may be on at any one time. The interrupt is cleared when the input port is read. The latches are not cleared by the processor and are reloaded only when the strobe creates an interrupt.

MINIPAGE DIAGNOSTIC BOARD (10008-0620)
(This is an available option, HA-4013, which must be purchased separately.)

## 1.0 INTRODUCTION

The Minipage Diagnostic Board is a set of four PROMs which are programmed to perform a number of diagnostic tests on the HA-4000 Minipage Terminal. The test PROMs, mounted on a single board, replace the four program PROMs on the CPU board during testing; the various tests are accessed via the keyboard on the console and test results are displayed on the LED display on the console.

TESTS AVAILABLE

F1 CPU Board

Reads CPU board PROMs and checks for gross errors

Checks CPU board RAMS

Checks Real Time Interrupt system

Indicates general system operation

F2 Memory Board

Reads memory board PROMs and checks for gross errors

Checks subscriber memory

Reads all program PROMs on CPU and memory boards and checks for any common data bits in any PROM

F3 Program PROMs

Checks each PROM on both the CPU and memory boards

F4 PROM checksum

Performs a checksum on any program PROM

F5 Tone Generation System and Transmitter Keying

Exercises the tone generation board and transmitter audio system

F6 Tape Deck System

Exercises tape decks and dual tape deck interface board and sends recorded messages to the trunks and transmitter

F7 Trunk Interface Board, DTMF Receiver and Console Audio

Checks audio and control functions to and from telco trunks

Checks operation of the DTMF receiver

Checks console audio system

More information about the above tests is contained in the detailed Test Information below.

## 2.0 INSTALLATION

In using the test PROMs for troubleshooting the terminal, it is suggested that initially the CPU board (with test PROMs), combo board and console be installed with all other boards removed to insure basic system operation. (The CPU board with test PROMs will operate without the memory board). Later, other boards may be installed to perform further tests and to pinpoint other problems.

## 3.0 TEST INITIATION

The various tests may be entered at any time by using the keyboard on the console and pressing the FUNC button followed by the number button of the required test. The requested test and its results will be displayed on the LED display on the console. Pressing an "illegal" button will cause an "E" to be displayed.

During all of these tests, the ALARM light on the front of the cabinet should be lit as the CPU does not tend to the Alarm Holdoff Circuit.

Upon initial power-up of the terminal, test F1 is automatically executed.

## 4.0 TEST INFORMATION

### 1. F1 CPU BOARD

Upon power-up or pressing FUNC 1, the console should display the following:

| | | | | | | |
|---|---|---|---|---|---|---|
| F1 | - | 0 | - | 0 | - | 0 |
| test indication | | result of PROM TEST | | result of RAM test | | result of Real Time test |

Although the test results may be different (as explained below), the above display indicates that the CPU system is generally operating properly. That is, the 8080A CPU is fetching and executing instructions properly, the entire data bus and most of the address bus are intact, the 8224 clock generator and 8228 system controller are functioning properly, the console display system on the combo board and console are functioning, and the CPU board PROM memory reading circuit for the first PROM is operating properly.

(Test F1 is entirely contained in the first Test PROM and will work without any other PROMs or RAMs functioning.)

F1 PROM Test

This reads the first 50 bytes of data in each of the PROMs on the CPU board and checks that no 10 sequential bytes are the same. Normally, PROM data is quasi-random, thus 10 identical bytes indicates a gross error in the PROM reading circuit. For the test results, a 0 is displayed if no errors are detected, and an "E" is displayed if more than one PROM with errors is found, the number of that PROM is displayed.

NOTE: See tests F3 and F4 for more extensive PROM tests.

F1 RAM Test

This writes data into the 1K x 8RAM on the CPU board and reads back that data to check for integrity.

For the test results, a 0 is displayed if no errors are detected, and an "E" is displayed if more than one RAM with are detected. If only one RAM with errors is found, the number of that RAM is displayed.

Since each RAM chip handles a single bit of the data byte, detected errors can be pinpointed to specific chips.

Pushing the READ button on the console during test F1 will display the data bus error pattern as follows:

Display F 0 0 0 0 0 0 0 0

MSB LSB

(A "1" is used to indicate the position of an error)

| Data Bus Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| Ram Number | 4 | 7 | 8 | 6 | 5 | 1 | 3 | 2 |

Since the RAM IC's are not located on the CPU board in the same order as the data bus bits they represent, the above also cross-references a particular RAM to its data bit. Thus a display of F00100010 indicates problems with the third and eighth RAMS. (The READ function routine is on the second test PROM which must be operational to use the READ system).

NOTE: The RAM test writes data to a specific address then reads it back again; however, the test can not know if the correct address was in fact reached. Therefore, an addressing problem might not be detected by this test.

F1 Real Time Interrupt Test

This test enables the Real Time Interrupt requesting a 50 msec interval and then waits 51 msec. If a Real Time Interrupt is received after 47 msec before 51 msec, a 0 is displayed. Otherwise an "E" is displayed.

2. F2 MEMORY BOARD

Upon pressing FUNC 2, the console should display the following:

| | | | |
|---|---|---|---|
| F2 | -00 | - | 0 |
| test | result of | | result of |
| indication | PROM test | | subscriber memory test |

F2 PROM Test

The PROMs on the memory board are tested exactly as in the F1 PROM test. Note, however, that PROMs on the CPU board are number 1-4; on the memory board they are 05-20. PROM 18 (never installed) is skipped over by this test, but the optional call counter PROM 19 is checked-if missing, an error will be indicated.

NOTE: See tests F3 and F4 for more extensive PROM tests.

F2 Subscriber Memory Test

This writes data into the subscriber memories and reads it back to check for data integrity. The original subscriber information is then returned to the memory so that the memories should not be changed by this test; however, a malfunction in the subscriber read/write circuitry could cause the subscriber information to be altered or filled with random data.

A "0" in the display indicates that all six memory modules are installed and functioning properly. Otherwise, the number of the first uninstalled or malfunctioning module is displayed.

NOTE: The subscriber memory test writes data to a specific address and then reads it back again; however, the CPU cannot know if the correct address was in fact reached. Therefore, an addressing problem might not be detected by this test.

3. F3 PROGRAM PROMS

Upon pressing FUNC 3, the console should display the following:

| | | | |
|---|---|---|---|
| F3 | -00 | - | 00 |
| test | number of PROMS | | number of first PROM |
| indication | with errors detected | | with detected error |

This test checks each PROM on both the CPU and memory boards for any bit which is always the same (either always 0 or always 1). Due to the quasi-random nature of the PROM data, no bits should be always the same.

The number of PROMs which such bit errors and the number of the first PROM with a bit error displayed. PROM 18 (always missing) is skipped over. The optional call counter PROM 19 is tested and, if not installed, an error will be indicated.

Pressing the READ button while in test F3 will display the data bus pattern for the first PROM with a bit error as follows:

Display F 0 0 0 0 0 0 0 0

MSB LSB

(A "0" indicates a normal bit)

Data Bus Bit 7 6 5 4 3 2 1 0

(A "1" indicates a repetitive bit)

4. F4 PROM CHECKSUM

Upon pressing FUNC 4, the console should display the following:

F4 -

test

indication

Now enter a two-digit number fron the keyboard for the PROM number to be tested. (Numbers less than 10 should be entered 01, 02, etc.) After the second digit is entered, the data bytes in that PROM are read and accumulatively added, neglecting carries out of the eighth bit. As hex numbers are not available on the console display, the checksum is displayed in octal as follows:

| | | | | |
|---|---|---|---|---|
| F4 | - | 0 5 | - | 0 2 0 |
| test | | PROM number | | checksum |
| indication | | under test | | (octal) |

The four program PROMs, which were removed to insert the test PROMs, may be checked by inserting them in the socket for PROM 18 and requesting a checksum for PROM 18, or by using any four sockets on the memory board.

After a checksum is displayed, another two-digit number may be immediately entered for another PROM checksum without re-entering FUNC 4.

The PROM under test is constantly being read (until any other key is pressed) and its checksum calculated and displayed. If a checksum is calculated which is different fron its previous value, the dash (-) in the console display between the PROM number and the checksum will go blank to indicate that a discrepancy was found. Pushing the READ button

will display the checksum which initiated the discrepancy and stop the repetitive checksum operation. To resume the checksum test, re-enter the PROM number.

For Revisions A, B, and C Minipage software, the checksums should be:

| | | CHECKSUM (OCTAL | | | |
|---|---|---|---|---|---|
| PROM NO. | ADDRESSES | REV. A | REV. B | REV. C. | V30.0 |
| 01 | ØØØØ-Ø1FF | 135 | 135 | 135 | |
| 02 | Ø2ØØ-Ø3FF | 161 | 161 | 161 | |
| 03 | Ø4ØØ-Ø5FF | 011 | 011 | 011 | |
| 04 | Ø6ØØ-Ø7FF | 117 | 117 | 117 | |
| 05 | Ø8ØØ-Ø9FF | 020 | 020 | 020 | 317 |
| 06 | ØAØØ-ØBFF | 070 | 070 | 070 | 216 |
| 07 | ØCØØ-ØDFF | 224 | 224 | 224 | 056 |
| 08 | ØEØØ-ØFFF | 134 | 134 | 134 | 027 |
| 09 | 1ØØØ-11FF | 232 | 232 | 232 | 167 |
| 10 | 12ØØ-13FF | 157 | 157 | 157 | 227 |
| 11 | 14ØØ-15FF | 210 | 210 | 210 | 076 |
| 12 | 16ØØ-17FF | 265 | 265 | 265 | 210 |
| *13 | 18ØØ-19FF | 262 | --- | 357 | 210 |
| 14 | 1AØØ-1BFF | 154 | 154 | 154 | 277 |
| 15 | 1CØØ-1DFF | 355 | 355 | 355 | 030 |
| 16 | 1EØØ-1FFF | 042 | 042 | 042 | 231 |
| 17 | 2ØØØ-21FF | 102 | 102 | 102 | 031 |
| 18 | Use to check first four Program PROMs (000) | | | | |
| 19 | 24ØØ-25FF | 040 | 040 | 040 | 271 |
| 20 | 26ØØ-27FF | * | | | |

No PROM = 000

*262 for REV. A software, Version 4.0

357 for REV. B software, Version 4.0

**Checksum value will depend upon customer's call letters and tone table.

For Version 1.0 Test PROMS, the checksums should be:

| PROM NO. | ADDRESSES | OCTAL CHECKSUM |
|---|---|---|
| 01 | ØØØØ-Ø1FF | 271 |
| 02 | Ø2ØØ-Ø3FF | 047 |
| 03 | Ø4ØØ-Ø5FF | 316 |
| 04 | Ø6ØØ-Ø7FF | 031 |

5. F5 TONE GENERATION AND TRANSMITTER KEYING

Upon pressing FUNC 5, the console should display the following:

| | | |
|---|---|---|
| F5 | - 0 0 5 1 . 1 | Decimal point |
| test | frequency in | implied (Not |
| indication | hertz | displayed) |

With the tone generator board installed, this test turns on the tone generator, keys the transmitter, and at 10-second intervals changes the frequency generated. The tones are available at the transmitter audio screw terminals on the rear of the Minipage, or on the tone generator board at pin 11 of IC C06, a 4066 switch.

Approximately every 10 seconds, the frequency is doubled until the frequency goes above 2000 Hz; then the frequency is reinitialized to a low frequency, the value of which is derived from the frequency value reached above 2000 Hz. The frequencies are then again doubled as before.

While in test F5, pressing any button on the console other than READ or FUNC, will freeze the frequency generated at the value displayed on the console (and E5 will appear as the test indication). Pressing the READ button causes the frequency to be stepped immediately to its next value, and 10-second stepping resumes.

Pressing FUNC also freezes the frequency generated, but will clear the display, unkey the transmitter, and turn off the tone generator; however, the tone will still be present on the tone generator board at pin 10 of IC C-6.

6. F6 TAPE DECK SYSTEM

Upon pressing FUNC 6, the console should display the following:

| | | | |
|---|---|---|---|
| F5 | - 1 - | 1 | 1=trunk 1<br>2=trunk 2 |
| test | tape deck | trunk or | 3=trunk 3<br>4=transmitter |
| indication | under test | transmitter | |
| | | under test | |

This test starts with Deck 1, if present, and sends the recorded messages sequentially to each of the three trunks, if present, and the transmitter. Deck 2 is then exercised this way, after which the test re-initializes and tests Deck 1 again. The test repeats continuously until any key is pressed.

If a deck or a trunk interface board for a particular trunk is not installed, the test will skip over it. If neither deck is installed, or if the dual tape deck interface board is not installed, an "E" will be displayed for the tape deck under test.

The audio for the transmitter is available at the transmitter audio screw terminals on the rear of the cabinet. Audio for the trunks is available at the tip and ring screw terminals for the trunks on the rear of the cabinet; the trunk interface boards should be configured for selector level operation.

7. F7 TRUNK INTERFACE BOARD, DTMF RECEIVER AND CONSOLE AUDIO

Upon pressing FUNC 7, the console should display the following:

| | | |
|---|---|---|
| F7 | - 2 4 5 - | |
| test | trunk operation | result of dial, ringing |
| indication | (see list below) | DTMF tests |

Test F7 is performed on all three trunks simultaneously. Trunks may be configured for either end-to-end or selector level operation. Pressing FUNC automatically releases and resets the trunks, DTMF receiver, and console audio.

F7 Trunk Operation

This test is actuated by pressing a number button on the console from the list below. The associated operations described in the list are performed on the installed trunk interface boards. For complete testing of a trunk interface board, the F6 tape deck system test should also be executed.

Note that items 3 and 4 also control the console audio.

| Number | Trunk Operation |
|---|---|
| 1 | Telco line+seizure (OFF hook) |
| 2 | Telco line-seizure (ON hook) |
| 3 | Voice path ON to transmitter (also console audio) |
| 4 | Voice path OFF to transmitter (also console audio) |

| | |
|---|---|
| 5 | Tones OFF to Telco |
| 6 | Dial Tone ON to Telco (interrupted for busy tone) |
| 7 | Beep tone ON to Telco (14000Hz) |
| (8) | (Not Used) |
| 9 | Ringing tone ON to Telco (steady) |

F7 Dial Pulse, Ringing, DTMF Tests

If a trunk is configured for selector level operation, dialing numbers in on that trunk will cause the dialed number to be displayed. A party on a selector level trunk going "ON HOOK" will cause the display for the test result to go blank.

If a trunk is configured for end-to-end operation, telco ringing on that trunk line will cause a "C" to be displayed.

The "C" will be blanked when the ringing signal is not present. The ringing signal on an end-to-end line also causes the DTMF receiver to be switched to the ringing trunk. Now the DTMF digits may be displayed after the telco lines are seized (use F7 Trunk Operation 1-OFF hook). For the DTMF digits, a "U" is displayed to indicate a *, and "F" to indicate a #. Neither * not # is used in the Minipage program.

Although all three trunks may be installed simultaneously, care should be taken that simultaneous operations on different trunks do not result in misleading results.

# SECTION 4
# MAINTENANCE/TROUBLESHOOTING

## A. RECOMMENDED TEST EQUIPMENT

The following test equipment is recommended for use in HA-4000 Minipage system checkout and alignment:

| | |
|---|---|
| 1 | Volt-ohm meter, Simpson - Model 260, 270 or equivalent |
| 1 | Storage oscilloscope, Tektronix - Model 434 or equivalent |
| 1 | Audio frequency meter |
| 1 | Audio monitor (none specified) |
| 1 | Audio signal generator |
| 1 | 600 ohm load resistor |
| 1 | Rotary dial telephone or lineman's handset (Selector Level), or DTMF telephone (End-to-End) |
| 1 | Spare parts kit (several kits are available). Contact Spare Parts Dept. at (716) 244-5830 |

## B. ROUTINE MAINTENANCE

### Service Concept

Maintenance requirements for the HA-4000 are few and can be divided into two principle areas: routine or preventive maintenance performed on a regular schedule, and service maintenance or troubleshooting performed only as required. A properly devised and adhered to program of preventive maintenance will substantially reduce the need for troubleshooting, since most equipment faults results from improper system care.

**WARNING**

Hazardous voltages. Turn power off before removing cover from terminal.

Procedure

Routine maintenance consists of cleaning the terminal once annually. The top cover of the HA-4000 terminal should be removed and any accumulation of dust should be carefully vacuumed out. (Turn power off and always avoid using metal vacuum attachments). Every three or four months, the playback/record heads on the tape decks should be demagnetized and cleaned with head clearning fluid (available at any audio store).

## C. TROUBLESHOOTING PROCEDURES

General

The troubleshooting procedures presented here are intended only as a guide. They are not meant to handle every problem which might arise, but rather to help isolate a general area of trouble and indicate the most common solutions. This guide should be used by qualified field repair service technicians. If problems arise which are outside the scope of these instructions, contact Harris Corporation RF Communications Division, Field Service Department.

The HA-4000 system contains highly complex, computer-type equipment, so troubleshooting must proceed in a logical, orderly fashion. Before attempting to troubleshoot the system, read Section III, Operating Procedures, of this manual. A basic understanding of operating theory is an absolute necessity. Begin troubleshooting by tentatively isolating the problem to a subsystem or a group of subsystems. For example, if a single trunk interface fails to operate but all others function properly, the trouble is probably the trunk interface card. Suggested solutions for specific subsystem problems are presented under the following headings:

HA-4000 Terminal Failure
Console Failure
Page Failure
Transmiter Failure

HA-4000 MINIPAGE TERMINAL FAILURE

The HA-4000 terminal is equipped with a normally open alarm relay having a single pole, single throw open contact wired to the rear terminal strip, TS1 (see figure 2-1). The contact will close if:

1. The processor fails to function properly.

2. The dc voltages have changed from factory set reference levels.

3. Features 03 (Transmitter Alarm Enable) and 41 (Transmitter Alarm Time) are active, the alarm contact will close if the transmitter is externally busy beyond the time programmed by feature 41.

4. Diagnostic test 2 (see section 4, Test Mode, of Operating Procedures) fails, signifying a tone generation failure.

The following checks may be run for each of the above conditions:

CAUTION

Exposed 120 or 240 Vac.

1. To check for proper function of the processor see the Card Checkout description in the following section.

2. Dc power supplies may be checked by measuring the ripple and voltage on the 48 Vdc supply (see figure 2-3 for location of the Supervisory, 48 volt power supply). Use an oscilloscope isolated from ground (use a three prong to two prong ac adapter). Attach a probe to +S on the power supply and the scope ground to -S on the power supply. The output should b be 48V $\pm$5% and 50 mV ripple peak-to-peak, maximum. To check the logic power supply (see figure 2-3), connect the oscilloscope ground to the chassis and the probe to terminal 3 of TB1. The output should be +5V $\pm$5% and 50 mV ripple

peak-to-peak maximum. The ±12V can be checked at TB2 terminal strip. The +12V is connected at 1 and -12V at 7 (the oscilloscope is still grounded to the Minipage chassis). Output voltages should be within ±5% and 50 mV peak-to-peak ripple, maximum.

LOGIC POWER SUPPLY TEST POINTS (see figure 2-3)

| | | |
|---|---|---|
| +5V | TB1-3 | Adjust output A potentiometer |
| +12V | TB2-1 | Adjust output B potentiometer |
| -12V | TB2-8 | Adjust output C potentiometer |

Test 48V across TB1-4 and TB1-7 on supervisory power supply.

3. Check to see if the Transmit light is on, indicating that the transmitter is being keyed by the Minipage. (see section on Transmitter Failure following).

4. For tone generation check, reference the Card Checkout description which follows.

CARD CHECKOUT

(For detailed functional descriptions of cards and boards, see section I. of Operating Procedures). The following is a guide for checking the operation of each card in the HA-4000 Minipage terminal, without the use of the Diagnostic Package P/N 10008-0620, and when it is suspected that one or more of the cards may be causing general system failure. A general system failure is considered to be when the alarm light is on, the power is on, and no pages are being transmitted either via trunks or manually through the console.

Perform the following in order:

CARD SWAP TEST

a. Set POWER switch to OFF ("power down"). Wait at least 30 seconds. Remove HA-4000 terminal cover by removing two phillips head screws, then reset all cards (interchanging positions may be desirable as long as components face the rear), and make a visual check of all cable connections and IC's for proper seating in sockets. Restore power and make a manual page.

MINIMUM CONFIGURATION TEST

If the terminal is still not operational, continue checkout with the minimum configuration of cards in the terminal as follows:

a. Power down, wait 30 seconds and remove all cards except:
   Central Processor Unit (SPU)
   Memory Card
   Combo Card
   Mother Board
   The console must be cabled to the Minipage. These cards are necessary for the minimum configuration for operation and are the starting points for eliminating faulty cards in the system.

b. Restore power. Enter and read subscriber memory (see Section F of Operating Procedures).

c. If memory loads (ENTERS) and retrieves (READS) correctly, the cards in the minimum configuration are basically operational.

d. If memory does <u>not</u> load or retrieve correctly, replace the memory card and/or subscriber memory card, reprogram and attempt to load and retrieve again.

If problems still exist, check voltage on batteries located on subscriber memory board. If sufficient, replace the CPU card because the operating program is contained on both the CPU card and the memory card.

e. If problems persist, replacing the combo card should prove successful upon repeating step d.

TONE GENERATOR CARD TEST

a. Install the tone card which was removed previously, after power down and 30 second wait.

b. Enter the following into memory:

000102020, once entered, depress the CANCEL button, and enter 000. The 000 should appear on the righthand side of the console display and tones should be audible on a transmitter monitor.

c. If tones are <u>not</u> audible the tone generator card is probably faulty. Use an oscilloscope to check for a 2.0V (approximate) peak-to-peak tone signal on edge connection 68 while the tones are being transmitted. If the tone generator card is faulty, replace it and run step 6 again. If the tones are heard, the problem with the tone generator card has been corrected. Proceed with the next check.

If some tones are operational and others are not, the malfunction is most likely located on the tone generator card.

TRUNK INTERFACE CARD TEST

NOTE

All trunk cards should be jumper configured for Selector Level Input (see section B of Operating Procedures).

If there is more than one trunk card, repeat step b. of this procedure with each one.

a. Power down, wait 30 seconds and install one trunk card.

b. Initiate a call to location 000 through the Telco by using a telephone and dialing into the terminal (000 should have a valid number).

c. If the test is successful, tones should be audible at a transmitter monitor, indicating that the trunk card tested is operational.

d. If step b fails, perform the following:

1. Check for proper programming of the offset and phantoming features. (Described in section 3, E. for Features 04, 05 and 06).
2. Disconnect Tip and Ring from Telco and dial 000 with a handset.
3. Be certain the 48 volt power supply is operational.
4. If this fails, the trunk interface card is probably faulty. Replace with known good trunk card and repeat step b.

END TO END CARD TEST

This applies to ETE programmed systems only.

a. Power down. Reconfigure trunk card jumpers for ETE operation.

b. Install ETE card and restore power.

c. Perform a call from an external phone and observe for normal supervisory tones. If this is not successful, the ETE card is probably faulty. Replace the ETE card and retest with a known, good trunk card.

At this point any problems within the terminal relating to the cards and boards should have been pinpointed and corrected.

CONSOLE FAILURE

The HA-4000 Minipage console may be suspected of faulty operation based on the following observations:

The console appears non-functional, i.e., no LED's lighted, cannot perform any functions, microphone (if installed) does not faunction. Perform the following:

KEYSWITCH AND CONSOLE CHECK

a. Make a visual check of the connector cable from the terminal cabinet to the console to verify good connection.

b. Check that the FUNC ENABLE keyswitch located on the rear of the console (see figure 3-2) is in the horizontal position. None of the five modes can be enabled until this keyswitch is properly activated.

c. Initiate the Self Test Mode (as described in section H of Operating Procedures). If Self Tests 1 through 3 run correctly, the console is considered basically operational. Also, try to enter and clear each digit on the console keyboard.

d. If the Self Test mode cannot be entered and the console remains non-functional while the terminal itself is functional, the console board inside the console should be replaced.

e. If the console is still inoperative, replace the Combo card and repeat step c.

TRUNK INTERFACE FAILURE

After verifying that the terminal and the console are both functioning properly, the trunk interface(s) may be checked as follows:

Single Trunk Failure

a. If a single trunk is operating improperly or is suspected of improper operation, bridge a lineman's handset (or a rotary dial telephone via a 1K build out resistor) across the trunk input.

b. Dial a three digit number (as required by the terminal) and checkout proper operation.

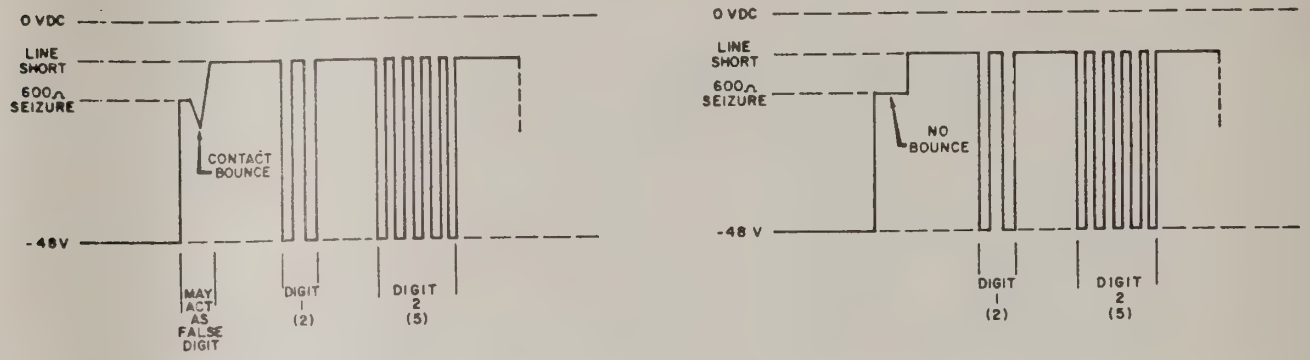
c. If the trunk now operates correctly, reconnect the line and connect an oscilloscope across the incoming telephone line.

d. Using an outside line, dial into the trunk.

NOTE

Lower order trunks must be busied out at the telephone office. For example, if trunk 3 is being checked, trunks 1 and 2 must be busied).

e. Observe the pulse train coming into the terminal and determine if excessive contact bounce or excess digits are present, as in the illustration.




f. If either condition is present, the trouble is with the telephone company equipment and the telephone company should be contacted to correct the problem.

g. If the trunk still does not function, check the loop current with a VOM in the line. Current value should be 25 mA to 30 mA.

NOTE

For terminals which are connected to an ESS Central Office, or which are physically close to the Central Office, steps h and i may have to be performed.

h. Desensitize the MCT-2 coupler by installing a 180-200 ohm resistor across pins 1 and 2 of MCT-2 at D4 of the trunk interface card.

i. Change the 1.0 uf capacitor at C4 of the trunk interface. The capacitor value may have to be changes to as large as 5.0 uf in some cases.

j. Check for seizure actuation by connecting a VOM across Tip and Ring. Dial in a page from an outside telephone. VOM should indicate reverse polarity for at least 6 seconds after the call is received.

k. Adjust the Audio Gain Control (see Section III, Level Adjustments).

l. Check that phantom/offset options are programmed as required.

MULTIPLE TRUNK FAILURE

If several trunks are malfunctioning, troubleshooting should proceed as described for single trunks. Simultaneous trouble on all trunks is usually indicative of trouble with the Central Processor or the DTMF circuitry rather than the Trunk Interface circuitry. It should be noted that occasional trouble in the telephone company's central office (C.O.) may result in failure on all trunks, so lines from the C.O. should be verified.

TRUNK FAILURE WITH END-TO-END SYSTEMS

a. Check to be certain Tip and Ring are connected properly.

b. Install known good trunk card in position, following power down and 30 second wait.

c. Reconfigure jumpers for ETE operation.

d. Attempt calling in a page on ETE, if this fails there is probably a problem with the ETE card.

e. If this test is successful, the trunk card is functional. Repeat the test with each trunk card.

APPARENT PAGER FAILURE

Under conditions whereby the Minipage terminal is functioning properly but one or more pagers are not operating, perform the following:

a. Using an oscilloscope, check the amplitude of the tone signal being transmitted across the transmitter Tip and Ring. Observe for proper waveform. (See illustration in Trunk Interface section).

b. If it is not possible to obtain a waveform of the proper amplitude from the transmitter Tip and Ring lines, disconnect the transmitter and install a 600 ohm load resistor across transmitter Tip and Ring.

   If the load resistor installation corrects the problem, this is an indication that a loading or impedance matching problem exists between the Minipage terminal and the transmitter.

c. Check the frequency of the tones going out to the transmitter by connecting a frequency counter with a probe connected to the TX audio Tip and the ground to TX audio Ring.

   Initiate a page of a frequency known to be faulty.

   NOTE

   Use a double tone page, i.e. program in 000 102020, so that the tone will be of a longer duration while monitoring.

   If frequency is incorrect (compare with tone chart), return the board for repair.

d. Check for signal distortion by observing for an unclipped sine wave using an oscilloscope, and monitoring the same test points as step c.

Example:


e. Check for positive keying closure using a VOM across keying closure pairs 1, 2 and 3 and terminal strip TS1-. If closure is not occurring, replace the faulty relay and check again; if still not operational check out the combo board.

Look for the resistance reading to change from infinite resistance to zero resistance upon closure.

Refer to Combo card checkout procedure, step e of Minimum Configuration Test. If Combo Card does not check out, replace it.

f. Check that all programmable features have been programmed correctly. Refer to Table 3-1.

g. Check programming of subscriber memory for addresses which may be incorrect.

If subscriber memory programming changes following a power down operation, the memory may be in error. If the programmable features have to be reprogrammed, the subscriber memory module #1 may be faulty.

TRANSMITTER FAILURE

The inability to signal more than one pager associated with a transmitter can be caused by trouble in the terminal, the lines from the terminal to the transmitter, or the transmitter itself. Such troubles should never be overlooked in this type of problem.

a. Verify proper operation of the transmitter as follows:

Manually key the transmitter and monitor the channel for the presence of carrier. Also, check the frequency and deviation of the transmission, and for proper programming of subscriber memory.

b. After verifying that the transmitter itself is operational, perform the following:

Initiate a manual page. The page should be audible over the monitor receiver and the transmitter lamp on the terminal should illuminate.

If the tone is not audible, but the transmit lamp still illuminates, the problem is probably in the combo card or the tone generator card. Replace them and run the test again.

NOTE

If the Minipage is used with a shared transmitter, the EXTERNAL BUSY input to the terminal from another device could "lock-up" the Minipage. Disconnect the EXTERNAL BUSY temporarily to observe if this "releases" the Minipage and allows the transmitter to function properly.

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